2022 4th International Conference on Circuits, Control, Communication and Computing (I4C-2022), 21 - 23 December 2022

Contemporary Research Trends in Plant Leaf Disease Detection

Beena K
Department of CSE
K S Institute of Technology
Bangalore, India
beenak@ksit.edu.in

Sangeetha V
Department of CSE
Ramaiah Institute of Technology,
Bangalore, India
drsangeethav@msrit.edu

Deepa S R
Department of CSE
K S Institute of Technology
Bangalore, India
deepasr@ksit.edu.in

Vaneeta M
Department of CSE
K S Institute of Technology
Bangalore, India
vaneetam@ksit.edu.in

***Abstract*— Agriculture is the backbone of Indian economy. Crop yield is decreased due to various disease-causing organism on plants. Plant disease identification has major impact on the agriculture production with respect to crop quality and quantity. Disease infected plants show symptoms on many parts of the plant like leaf, stem, bud, flower, fruit and root. Early identification of the disease will prevent further crop loss. In this paper, four different sections are covered. The first section focusses on different types of disease and its symptoms. Second section discuss about different traditional methods of disease identification. And the third section cover methodologies that can be used for disease identification in plants through image processing, deep learning and convolution neural network techniques. Fourth section highlights challenges and future trends in disease identification. Finally, this paper reveals that, particularly in rural areas and underdeveloped nations, relying solely on the expertise of professionals to identify and categorize diseases can be very much time-consuming and expensive.**

Keywords—agriculture, convolution neural network, disease detection, deep learning, plant disease.

I. INTRODUCTION

Agriculture is method to feed growing population. Indian economy is dependent on agriculture. More than 70% of Indian population rely on farming. The significance of agriculture has dropped since the revolution of industrialization. Around 17% to absolute GDP is payable by the agriculture, hence it is important to solve issues faced by farmers in the field of agriculture. One of major issue is disease detection in plant which is threat to farmers because it causes reduction in yield as wells as quality [1].

The major driving factor that provides existence of life on the earth from lowest primitive in the food chain is plants. All these plants are susceptible to various diseases as they are exposed to the different climatic conditions of nature. Rapid identification of leaf diseases remains difficult due to the lack of the necessary changes in agriculture practice and infrastructure. Plant disease can cause adverse consequences to the farmers whose livelihood mainly depend on the market of healthy crops and they are the major trouble causers for the food security. In the evolving world, greater than 80 percent of the agricultural production are risen by the farmers. Yield loss of more than 50% is due to diseases and pests. Few decades here after, population is awaited to grow by 100 million a year, hence there is a constraint on usage of water, soil and many other natural resources. Due to these circumstances developing countries like India have to increase their food production twice in number to feed the growing population.

Farmer's financial cycle is dependent on the kind of crop they produce, which in turn depends on the plant's development and the final yield that they might get. Therefore, in field of farming, identification of diseases is a critical task [2]. Plants are the essential attribute for the survival of all the creatures on the Earth. Plant diseases are the key factor for the crop losses in the agriculture. Due to the importance of plants in the food chain, focus has to be given on the measures that can be taken to detect and diminish diseases in the plants. This paper presents a brief detail about common leaf diseases and methodology used to detect the same.

II. PLANT DISEASE TYPES WITH SYMPTOMS

Plants turns into diseased due to disruption caused by the causal agent which results in an abnormal physiological process that disturbs the plant's growth, normal physical structure, and many other activities. This involvement of the agent with any of the plant's essential physiological or biochemical systems turns into a symptom which can be characterized. Diseases in the plants are classified based on the features of the agent, which can be either infectious or non-infectious [3]. Plant diseases which are infectious are caused due to pathogenic organism such as a bacteria, fungi, mycoplasma, virus, nematode, or parasitic flowering plant. An infectious agent has ability of spreading the infection from one liable host to another or reproducing inside the same host. Plant diseases which are non infectious are caused due to unfavourable growing conditions, like temperature extreme, excess or deficiency of minerals, noxious components in soil, chemical changes in the atmosphere, changes in the composition of moisture and oxygen. Non-infectious agents do not carry organisms capable of reproducing within a host nor they are contagious. The various plant leaf disease with common symptom is listed below with brief information about the symptoms of the disease

A. Powdery Mildew

Powdery mildew disease affected in plants is indicated usually by the white dusty coating on flowers, stems and leaves as shown in Fig 1.

Fig 1. Powdery mildew leaf disease

2022 4th International Conference on Circuits, Control, Communication and Computing (I4C) | 979-8-3503-9747-5/22/$31.00 ©2022 IEEE | DOI: 10.1109/I4C57141.2022.10057867

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

SECOND INTERNATIONAL CONFERENCE ON ARTIFICIAL INTELLIGENCE, COMPUTATIONAL ELECTRONICS AND COMMUNICATION SYSTEM (AICECS) 2023

16-17 FEBRUARY 2023

IOP: Journal of Physics Conference

Manuscript: 28 (peer reviewed)

PARTICIPATION CERTIFICATE

This certificate is presented to **Dr Rekha B Venkatapur** for presenting the research paper entitled "**Traffic Controllinf in Smart Cities**" in the Second International Conference on Artificial Intelligence, Computational Electronics and Communication System (AICECS 2023), organized by Department of Electronics and Communication Engineering, Manipal Institute of Technology, Manipal. This paper has been submitted to be published in IOP: Journal of Physics, a conference proceedings journal by the Institute of Physics, United Kingdom.

Dr. Kumara Shama	Dr. Pallavi R Mane	Dr. Tanweer	Dr. Pramod Kumar	Dr. Shounak De
HOD-ECE, MIT Manipal	General Chair	General Chair	General Chair	General Chair

2022 4th International Conference on Circuits, Control, Communication and Computing (I4C-2022), 21 - 23 December 2022

Contemporary Research Trends in Plant Leaf Disease Detection

Beena K
Department of CSE
K S Institute of Technology
Bangalore, India
beenak@ksit.edu.in

Sangeetha V
Department of CSE
Ramaiah Institute of Technology,
Bangalore, India
deangeethav@merit.edu

Deepa S R
Department of CSE
K S Institute of Technology
Bangalore, India
deepasr@ksit.edu.in

Vaneeta M
Department of CSE
K S Institute of Technology
Bangalore, India
vaneetam@ksit.edu.in

***Abstract*— Agriculture is the backbone of Indian economy. Crop yield is decreased due to various disease-causing organism on plants. Plant disease identification has major impact on the agriculture production with respect to crop quality and quantity. Disease infected plants show symptoms on many parts of the plant like leaf, stem, bud, flower, fruit and root. Early identification of the disease will prevent further crop loss. In this paper, four different sections are covered. The first section focusses on different types of disease and its symptoms. Second section discuss about different traditional methods of disease identification. And the third section cover methodologies that can be used for disease identification in plants through image processing, deep learning and convolution neural network techniques. Fourth section highlights challenges and future trends in disease identification. Finally, this paper reveals that, particularly in rural areas and underdeveloped nations, relying solely on the expertise of professionals to identify and categorize diseases can be very much time-consuming and expensive.**

Keywords—agriculture, convolution neural network, disease detection, deep learning, plant disease.

I. INTRODUCTION

Agriculture is method to feed growing population. Indian economy is dependent on agriculture. More than 70% of Indian population rely on farming. The significance of agriculture has dropped since the revolution of industrialization. Around 17% to absolute GDP is payable by the agriculture, hence it is important to solve issues faced by farmers in the field of agriculture. One of major issue is disease detection in plant which is threat to farmers because it causes reduction in yield as wells as quality [1].

The major driving factor that provides existence of life on the earth from lowest primitive in the food chain is plants. All these plants are susceptible to various diseases as they are exposed to the different climatic conditions of nature. Rapid identification of leaf diseases remains difficult due to the lack of the necessary changes in agriculture practice and infrastructure. Plant disease can cause adverse consequences to the farmers whose livelihood mainly depend on the market of healthy crops and they are the major trouble causers for the food security. In the evolving world, greater than 80 percent of the agricultural production are risen by the farmers. Yield loss of more than 50% is due to diseases and pests. Few decades here after, population is awaited to grow by 100 million a year, hence there is a constraint on usage of water, soil and many other natural resources. Due to these circumstances developing countries like India have to increase their food production twice in number to feed the growing population.

Farmer's financial cycle is dependent on the kind of crop they produce, which in turn depends on the plant's development and the final yield that they might get. Therefore, in field of farming, identification of diseases is a critical task [2]. Plants are the essential attribute for the survival of all the creatures on the Earth. Plant diseases are the key factor for the crop losses in the agriculture. Due to the importance of plants in the food chain, focus has to be given on the measures that can be taken to detect and diminish diseases in the plants. This paper presents a brief detail about common leaf diseases and methodology used to detect the same.

II. PLANT DISEASE TYPES WITH SYMPTOMS

Plants turns into diseased due to disruption caused by the causal agent which results in an abnormal physiological process that disturbs the plant's growth, normal physical structure, and many other activities. This involvement of the agent with any of the plant's essential physiological or biochemical systems turns into a symptom which can be characterized. Diseases in the plants are classified based on the features of the agent, which can be either infectious or non-infectious [3]. Plant diseases which are infectious are caused due to pathogenic organism such as a bacteria, fungi, mycoplasma, virus, nematode, or parasitic flowering plant. An infectious agent has ability of spreading the infection from one liable host to another or reproducing inside the same host. Plant diseases which are non infectious are caused due to unfavourable growing conditions, like temperature extreme, excess or deficiency of minerals, noxious components in soil, chemical changes in the atmosphere, changes in the composition of moisture and oxygen. Non-infectious agents do not carry organisms capable of reproducing within a host nor they are contagious. The various plant leaf disease with common symptom is listed below with brief information about the symptoms of the disease

A. Powdery Mildew

Powdery mildew disease affected in plants is indicated usually by the white dusty coating on flowers, stems and leaves as shown in Fig 1.

Fig 1. Powdery mildew leaf disease

979-8-3503-9747-5/22/$31.00 ©2022 IEEE

International Conference on Computational Intelligence in Communications and Business Analytics

CICBA 2022: **Computational Intelligence in Communications and Business Analytics** pp 336–350

Real-Time Piracy Detection Based on Thermogram Analysis and Machine Learning Techniques

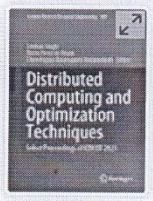
B. Sanjana ✉, M. Sirisha, Pruthvi Dinesh, G. R. Sunil Kumar & Surekha Borra

Conference paper | First Online: 22 July 2022

Part of the Communications in Computer and Information Science book series (CCIS,volume 1579)

Abstract

Movie Piracy is increasing these days, and it has a profound impact on the economic growth of film industries all over the world. Hence curbing piracy has become a critical step in avoiding massive losses to the film industry. This paper proposes a thermogram based anti-piracy system using Machine learning models. A local dataset is created by capturing the images in different scenarios by employing a thermal camera. AlexNet is used for extracting the features from captured images and the extracted features are trained with several Machine Learning models in MATLAB for their performance



Distributed Computing and Optimization Techniques pp 219–229

Chronological-Squirrel Earth Worm Optimization for Power Minimization Using Topology Management in MANET

B. Devika ✉ & P. N. Sudha

Conference paper | First Online: 12 September 2022

Part of the Lecture Notes in Electrical Engineering book series (LNEE,volume 903)

Abstract

This paper developed a Chronological-Squirrel Earth Worm optimization (C-SEWO) algorithm in MANET for clustering using the topology management. The clustering is performed based on the developed C-SEWO approach and objective functions. The proposed C-SEWO algorithm is designed by combining the Chronological-Earth Worm Optimization algorithm (C-EWO) and Squirrel Search Optimization Algorithm (SSA). Further, the objective functions are computed in terms of the factors, like power, mobility, connectivity, distance, and link lifetime. After the cluster selection, every node in the cluster generates the Gabriel graph for equivalent cluster, then every node updates the file of the neighbor and also preserves graph connectivity and regulates transmission power using the

Design Studies and Intelligence Engineering
L.C. Jain et al. (Eds.)

doi:10.3233/FAIA220716

In-Theatre Real Time Piracy Detection and Discouraging System

Pruthvi Dinesh [a], Sanjana B [b], Sirisha M [c], Sunil Kumar G R [d] and Surekha Borra [e,1]
[a-e] *Department of ECE, K.S. Institute of Technology, Bangalore, Karnataka, INDIA*

Abstract. Today, movie piracy is greatly affecting the economic growth of the film industry. Hence, combatting piracy is critical in averting losses for the film producers. This paper aimed to develop an anti-piracy model composed of a real time pirated video degradation system and a piracy activity estimation system, which in turn are based on Thermogram analysis and an ARDUINO programmed IR LEDs array. In the pirate estimating system, the Cubic SVM model is trained to classify the thermal images acquired from the theatre environment into normal and abnormal classes. An accuracy of about 99.9% is achieved in real time while testing for piracy actions. The proposed piracy discouraging system is programmed to real time degrade the quality of pirated video and to invisibly watermark the pirated video with the theatre name, date, and time information. The distortion created by our prototype system is evaluated by recording the video displayed on screen using different mobile cameras and the corresponding pirated video quality is compared objectively and subjectively. Based on the subject's quality rating, it was found that the system has created enough degradation in the visual quality of pirated video to discourage piracy.

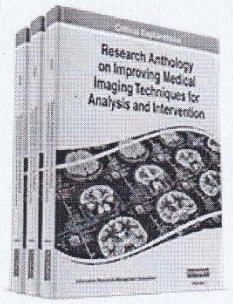
Keywords. Alex Net, Camcorder, Movie Piracy, SVM

1. Introduction

Cinema is the major source of entertainment for people all over the world. Movie piracy is the act of unauthorized acquisition of copyrighted content without the authorization of film makers. This is a new epidemic that is economically impacting the film industry on a global level. According to a survey [1-5], pirated movies gain around 230 billion views every year. It was also reported that Indian media lost about US$2.8 billion to piracy. As per the study conducted by the US-India Business Council (USIBC), the Indian film industry experiences a loss of 11% in employment due to piracy. It also influences content creation by discouraging filmmakers, directors, and producers from making sequels and remakes. Consequently, national government and entertainment firms have come up with effective strategies and tools to combat piracy. The Indian government implemented the Cinematograph Act in the year 2019 that declares piracy as a crime and penalizes pirates with three years of imprisonment and with a fine of 10 lakh rupees.

Movies can be pirated before they are released, which is known as pre-release piracy [6-10]. On the other hand, if a movie is pirated after the release, it is known as post-release piracy. In the pre-release piracy, a movie is recorded by guests or theatre operators during private screenings for VIPs and critics.

[1]Surekha Borra



Detection and Classification of Leukocytes in Blood Smear Images: State of the Art and Challenges ⊗

Renuka Veerappa Tali, Surekha Borra, Mufti Mahmud

Source Title: Research Anthology on Improving Medical Imaging Techniques for Analysis and Intervention (/gateway/book/308672)

Pages: 32
ISBN13: 9781668475447ISBN10: 1668475448EISBN13: 9781668475454
DOI: 10.4018/978-1-6684-7544-7.ch057

Abstract

Manual analysis of microscopic blood smears by highly expert pathologists is labor-intensive, time-consuming, and is subject to inter-observer variations. Recent innovations in image processing and computer vision techniques have improvised digital pathology in terms of objectivity and reproducibility. Traditional computer vision-based methods of recognition of white blood cell (WBC) from a pathological blood smear image includes the process of detection, segmentation, and classification. This paper presents a review of state-of-the-art detection, segmentation, and classification techniques for white blood cell analysis. The goal of this work is to present an introduction to the field, provide enough information about the analysis methods developed so far, and to be an appropriate reference for the researchers looking forward in this field. The methods under review are classified into intensity and feature based. The crucial steps involved in these techniques, mathematical foresights, performance evaluation techniques, issues, and future directions are discussed.

graphene/h-BN heterostructure is investigated. The variations of lateral force during the sliding process with SW defects on the topmost layer are measured and compared with defect-free heterostructure cases.

PAPER ID - 23

An Investigation on the Mechanical and Durability Properties of Concrete structures incorporated with Low Carbon Steel – Industrial Waste

Nirmala L[a]*, Tejaswini M L[a] , Shilpa M L[b] and Bhavan Kashyap K[a]
[a]K.S.Institute of Technology, Bangalore, Karnataka, 560109.
[b]Christ University, Bangalore, Karnataka, 560029.
Corresponding author email: bhavankashyap201@gmail.com

Abstract
This work focuses on the use of steel slag of low carbon – an industrial waste as a fractional substitution of coarse aggregate for its utilization in cement concrete and building construction. The waste material produced annually during the manufacturing of low carbon steel components leads to major economic and environmental problem. Hence the work aims at utilizing the waste in concrete to develop sustainable building materials. In this study, two samples of concrete mixture were set with 0% and 20% low carbon steel as coarse aggregate. Initially mix design of concrete for M40 grade was done. The strength of compression, tension, and flexure for low carbon admixed concrete increased substantially. Water absorption of concrete admixed with low carbon steel was substantially minimum in contrast with concrete without low carbon steel. The outcome of acid attack and sulphate attack tests infer that the properties of both admixed and normal concrete were not substantial. This work suggests 20% low carbon steel slag is an optimum content as a fractional substitution to coarse aggregate.

PAPER ID - 24

Synthesis and characterization of Al7075 Micro composites with MgO/Mn

Avyakth S Shekar, Balgopal C, Akshay Vasista B, Taniya Kaushik, Sateesh Mudalagi
Department of Mechanical Engineering, PES University, Bangalore, Karnataka, 560085
Corresponding author email: avyakthshekar007@gmail.com

Abstract
The evaluation of corrosion resistance, hardness and tensile strength of the stir casted Al7075 alloy and Al7075 with 4%MgO and 4%MgO/1.5%Mn has been done via Salt spray analysis, Rockwell's Hardness Machine and Universal Testing Machine. Al7075 alloy was melted at 700°C with reinforcements added, the mixture was then poured into sand molds. The microstructure of the casted samples of compositions Al7075+4%MgO and Al7075+4%MgO+1.5%Mn were studied using scanning electron microscope (SEM) which shows the presence and even distribution of the reinforcements added. Hardness test was conducted on all the compositions of the casted and heat-treated samples prepared with a steel tip indenter of diameter 10mm. Tensile test was conducted at an ambient temperature of 27°C. The yield stress, percent elongation, and ultimate tensile strength were determined for the cast and heat-treated samples. The corrosion test was conducted in a salt

EMISSION REDUCTION OF DIESEL ENGINE BY USING COMBINATION OF AFTERTREATMENT DEVICES

Nagaprasad K S[1], Molakalu Punith[2], Rajesh Kumar Kodi[3], Ranganatha Swamy L[4], Shankara Naik L[5], D Madhu[6]
[1]Associate Professor, [2]Assistant Engineer, [3]Bio-energy research and quality assurance laboratory,.[4]Associate Professor,[5]Associate Professor, [6]Professor
[1]K.S. Institute of Technology, Bengaluru, India,
[2]Abamka Technical Pvt. Ltd., Kolar, India,
[3]University of Agricultural Sciences, Bangalore, India,
[4]BGS Institute of Technology, B.G.Nagara, India,
[5]Government College of Engineering, Haveri, India
[6]Government College of Engineering, Ramangaram, India

Abstract: Engine manufactures efforts to meet more and more stringent standards is done by adopting aftertreatment devices. Many aftertreatment devics viz; Diesel particulate filter (DPF), Diesel oxidation catalyst (DOC), Selective Catalytic reduction (SCR), NOx traps etc., induce significant gain in emissions reduction were tried. In this study, three post treatment devices viz; diesel particulate filter, diesel oxidation catalyst and new catalytic converter were fixed at exhaust pipe of engine. Experiments were conducted on a diesel engine adopted with these aftertreatment devices individually and also combined. All tests were conducted at different loads viz. 4 kg and 6 kg load. At 6 kg loads, the thermal efficiency of engine is found to be 21.45%. Overall comparison of all the results, the least emission level was recorded when engine is operated at sixty percent full load with combined DPF, DOC and new catalytic converter; with emissions values were HC 40 ppm, CO 0.1 %, and NO 332 ppm.

Keywords: Compression Ignition engine, Catalytic Converter, Diesel Engine Exhaust.

1. INTRODUCTION

The capability to operate with leaner air fuel ratio and utilization of higher compression ratio are the two integral determinants that validates the immense thermal efficiency and substantial specific power output of the CI engines concurrent with fuel economy that publicizes their deployment as most proficient prime movers in the areas of farming, industries and transportation across the globe. In contrast, diesel engines are the leading benefactor of oxides of nitrogen (NOx) and particulate matter (PM) emissions erupted due to cumulative premixed flame combustion and diffusion flame combustion that ruins the health of an individual. In spite of an injection of water and hydrogen peroxide and Exhaust Gas Recirculation (EGR) in to combustion chamber of a CI engine are the renowned approaches of mitigating the in-cylinder formation of NOx and particulate emission, EGR and water injection routines exceptionally cut down NOx and no sizable betterment in the attenuation of PM could be perceived; while, conflicting sequel is derived with an injection of hydrogen peroxide. Refinements in the engine geometry and revisals of diesel fuel with an addition of oxygenating agents such as biofuels to enhance the cetane number and fuel volatility are the supplementary means that setback to concurrently downsize the in-cylinder formation of NOx and PM. The use of after treatment devices such as Diesel particulate filter (DPF), Selective Catalytic Reduction (SCR), Diesel oxidation catalyst (DOC), NOx traps etc., are the post combustion techniques adopted to reduce the tailpipe emission of NOX and PM.

Although, the usage of water-in-diesel emulsions for diesel engine applications exhibited optimistic consequences, showed trade-off in terms of efficiency and NOx emissions. The blends of diesel-biodiesel 80:20 by volume have shown favourable sequels in terms of engine emissions and performance parameters. The outcome of the experimentation with a fuel composed of blend of Diesel-Neem biodiesel (80:20) supplemented with 5% water (by volume) and 1% surfactant (by volume) along with 0.5% Di-tertiary butyl peroxide (by volume) unveiled the improved performance with diminished specific energy consumption and attenuated NOx emission of 45% and 29% compared to that of diesel-biodiesel blend and

diesel fuel respectively [1]. The exertion of DPF instigated in the diminishment of soot by 40% was noticed at full loading conditions [2]. The experimentation with the utilization of low-cost catalyst composed of silica, alumina and activated charcoal on single cylinder engine under full loading conditions ascertained that emission of NOx shortened by 21% in contrary to the engine operation with catalyst of noble metals [3]. The demonstration on diesel engine fuelled with the blends of diesel-biodiesel with electrochemically activated cells composed of CuO–YSZ electrolyte and CuO–YSZ electrolyte with BaO coating has concluded the considerable NOx adulteration with coincidental decrement of emissions of HC and PM [4]. The engine ran with blend of 40% biodiesel extracted from chicken skin-diesel incorporated with copper doped zeolite coated catalyst at 4.3 kW load have shown explored the slashed emissions of HC, CO, NOX and smoke 9.71%, 5.32%, 11.3%, and 34.9% analogous to the catalysts available commercially [5]. The exploitation of urea -water SCR system with an engine operated with a blend of 25% madhuca indica bio-diesel -diesel blend shown-off declined emissions of HC and NOx by 5.8% and 1.2% in contrast to base diesel fuel [6]. Exertion of nanoparticles in the biodiesel-diesel blends results in better atomization of the fuel, reduced ignition delay and hence accelerates the combustion and inevitably decline the particulate emission. The deployment of Al_2O_3 nanoparticles 25-100 ppm in steps of 25 ppm with 20% microalgae biodiesel-80% diesel blend has shown positive impact on the thermal efficiency and considerable decrement in the NOx emission with 50 ppm of Al_2O_3 nanoparticles in the blend compared to the biodiesel-diesel blend [7]. Addition of 25 ppm zirconium oxide (Zr2O3) nano additives in B20 spirulina microalgae biodiesel blend (20% spirulina microalgae biodiesel + 80% diesel fuel) revealed that inhabitance of Zr2O3 nano additives in B20 blend effectuated in lowering BSEC by 4.9%, elevated BTE by 7.9% and adulterated NOx emissions by 9.4%. [8]. The adoption of multiwalled carbon nano-tubes in the mass fraction of 25 ppm palm methyl ester/ jatropha methyl ester on the diesel engine exhibited a considerable betterment in performance and minute attenuation in terms of emissions [9]. The trials on the diesel engine with the nanoparticles unveiled the substantial decline in the emissions of NOx and CO compared to that with the base diesel operation alone [10].

2. EXPERIMENTAL SETUP

Fabrication of New Catalytic Convertor

Catalytic converter consisted of platinum, paladium and rhodium metals with the composition of 3:1:1. Platinum was dissolved in the solution of hexa hydrated aluminium chloride ($AlC_3.6H_2O$). The prepared solution was washed, coated to the ceramic substrate which is honeycomb structure. Two-dimensional design and three-dimensional model of catalytic convertor is shown in figure 1 and 2 respectively. The photograph of cutting process and welding of catalytic convertor during the fabrication is shown in figure 3 and 4 respectively.

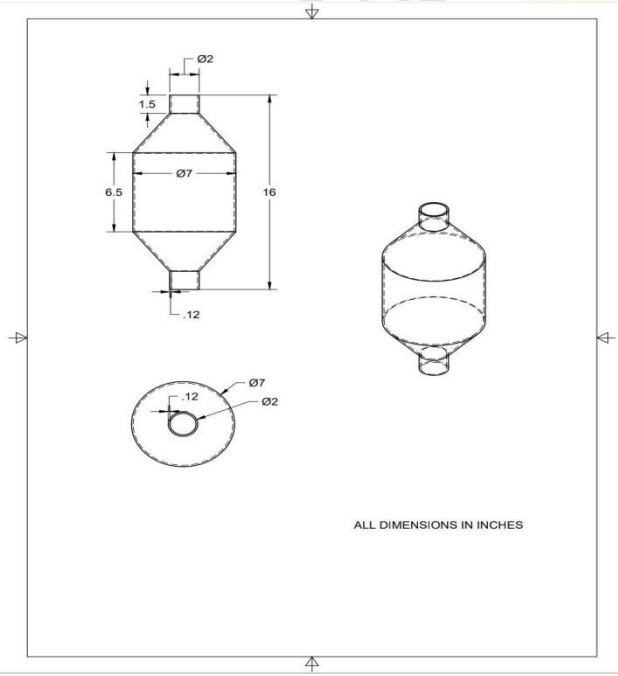


Figure 1 Two-dimensional design of Catalytic Converter

Figure 2 Three-dimensional design of Catalytic Converter

Figure 3 Cutting of sheet metal

Figure 4 Welding of New Catalytic Converter

Experiments were conducted on a diesel engine having three aftertreatment devices. The engine specifications are shown in the table 1. All tests were conducted at different loads like, zero, sixty percent and eighty percent full load. The engine speed was maintained at 1500 rpm. After every load, the engine was allowed to attain steady state for 15 minutes. The specification of DPF, DOC and Catalytic Convertor is given in table 2, 3 and 4 respectively. Figure 5 shows the Diesel Engine used for the test runs. The three aftertreatment devices are shown in Figure 6, 7 and 8 respectively. The photograph of Diesel engine's exhaust having DPF,DOC and Catalytic converter and Diesel engine's exhaust having Catalytic converter only shown in figure nine and ten respectively.

Figure 5.Diesel engine test rig

Table 1 Specification of the compression ignition (CI) engine

Type of Ignition	CI
No of Cylinders	1
Rated Power	3.68K W
Rated Speed	1500RPM
Bore × Stroke	80mm × 110mm
Compression ratio	18:1

Figure 6 Diesel Particulate Filters

Table 2 Specifications of Diesel Particulate Filter

DPF core	150mmX150mm
Volume	2Liter
Cell Density	100cpsi
Material	Cordierite
Chemical Composition	Al2O335.2±1.5 % SiO250.9±1.5 % MgO13.9±1.5 %
Compressive Strength	=10Mpa
Porosity	=45 %
Maximum Use Temperature	=1200 ℃
The average of pore diameter	7-10 μm
Can thickness	1.2 mm
Total Length	400 mm
PGM	15 g/ft Pt/Pd=3/1
PGM loading	15 gm/ft^3

, , , ,

Figure 7 Diesel Oxidation Catalyst

Figure 8 Catalytic Converter

Table 3 Specifications of Catalytic Converter

Cell Density	500 cpsi
Material	Mild Steel
Total Length	375 mm
Ceramic Substrate	Honey Comb Structure

Figure 9 Diesel engine exhaust having DPF,DOC and Catalytic converter

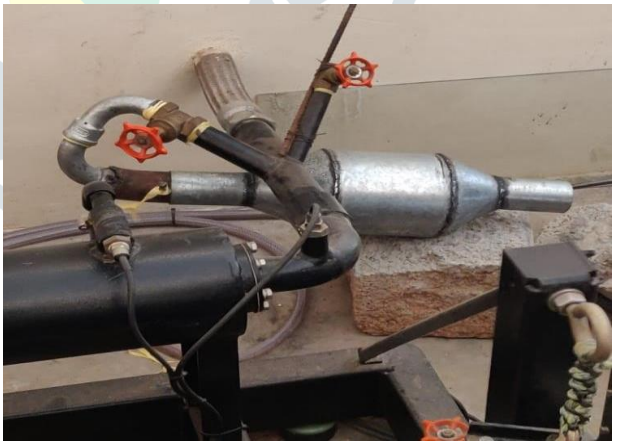


Figure 10 Diesel engine exhaust having Catalytic converter only

3. RESULTS AND DISCUSSION

Experimentations were carried out on a CI engine with diesel fuel and speed is maintained at 1500 rpm. The IP is 205 bar, IT is 23° BTDC, having HCC and three hole injector; each hole being 0.3 mm diameter as specified by manufacturer were adopted.

BTE of the engine with/without devices was found to be 15.77 % and 16.47 % at 4 kg and 6 kg loads respectively. In addition, the measured emissions are HC is 91 ppm, CO is 0.14 %, CO_2 is 6.62 % and NO is 435 ppm at 4 kg load.

3.1 HC emissions

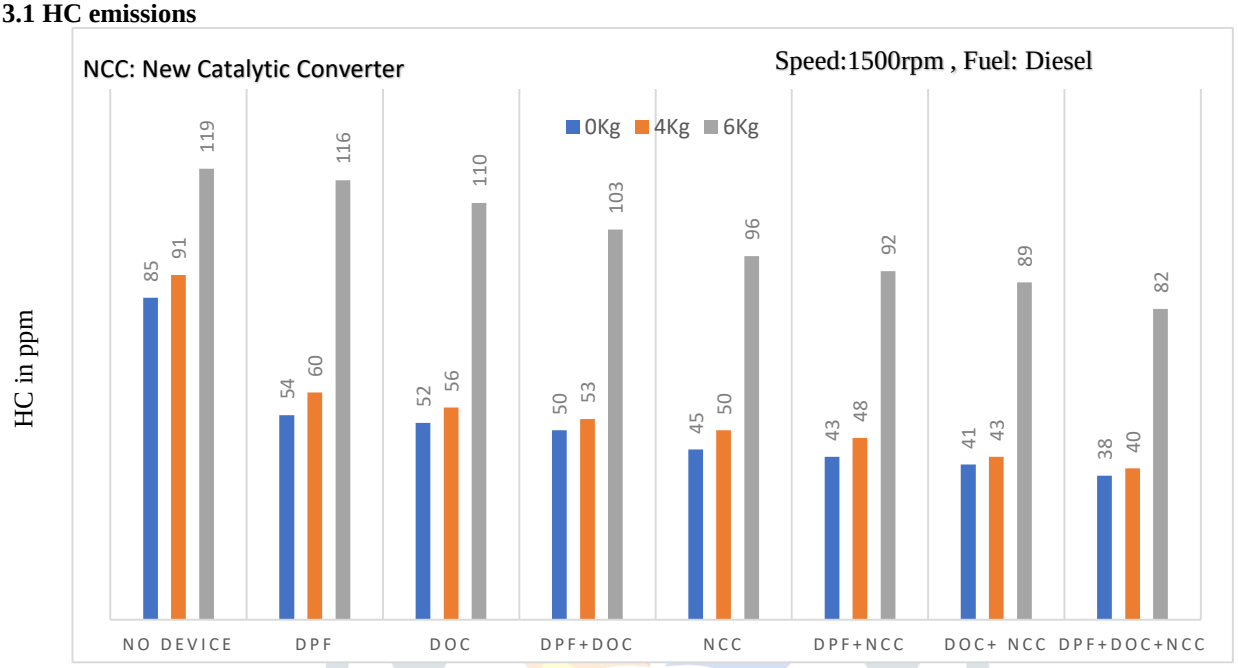


Figure 11 HC emissions at 0 kg, 4 kg and 6 kg load

Without incorporating any post treatment devices, HC emissions was found to be 85 ppm in the exhaust at no load condition as shown in figure 11. It reduces further to 54 ppm with DPF only, 52 ppm with DOC only, 50 ppm with both DPF and DOC; 45 ppm with new catalytic converter only, 43 ppm with both DPF andCatalytic converter, 41 ppm with both DOC and new catalytic converter and 38 ppm with combination of all three devices viz; DPF, DOC and new catalytic converter. Emissions were reduced because of New Catalytic Converter has been used. Emissions, which are released from diesel engine, were reacted with Platinum Group Metals (Platinum, Palladium, and Rhodium) which is coated inside the New Catalytic Converter. Platinum and Palladium are acts as oxidation process while Platinum and Rhodium are acts as Reduction process [6]. Emissions are decreased more when the combination of these three aftertreatment devices.

3.2 CO emissions

At 6 kg load and without incorporating any devices, CO emission is 0.26 % in the exhaust as shown in figure 12. It reduces further to 0.24 % when DPF is used, 0.22 % when DOC is used, 0.19 % when DPF and DOC used, 0.17 % New Catalytic Converter is used, 0.148 % when DPF and Catalytic converter is used,0.138 % when DOC and Catalytic converter is used and 0.13 % when combination DPF, DOC and Catalytic Converter is used.

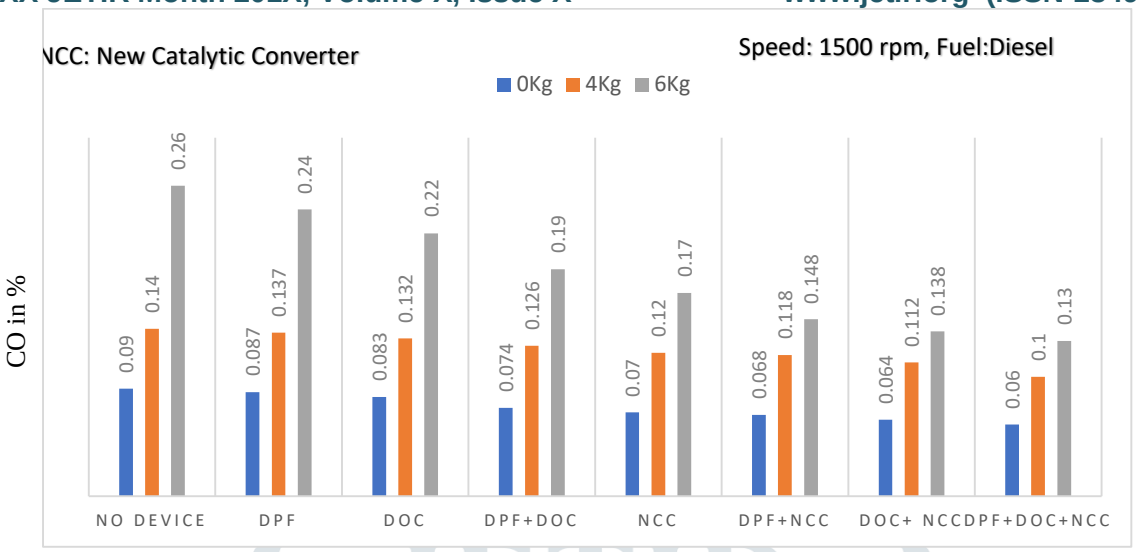


Figure 12 CO emissions at 0Kg, 4Kg and 6Kg

3.2 NO emissions

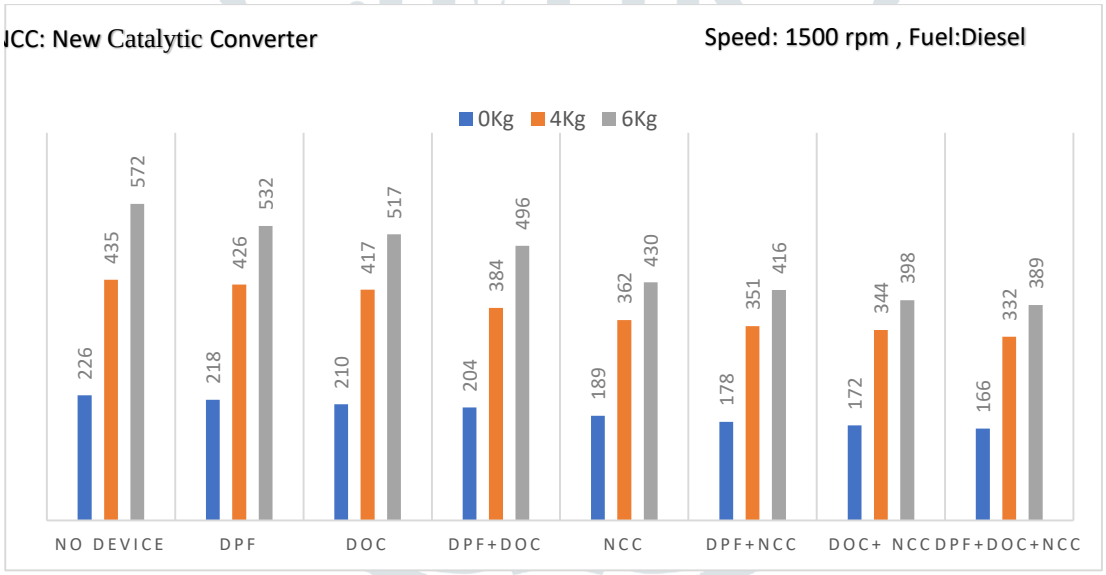


Figure 13 NO emissions at 0Kg, 4Kg and 6Kg

At 4 kg load and without incorporating any devices is 435 ppm of NO emissions present in the exhaust as shown in figure 13. It reduces further to 426 ppm when DPF is used, 417 ppm when DOC is used, 384 ppm when DPF and DOC used, 362 ppm New Catalytic Converter is used, 351ppm when DPF and Catalytic converter is used,344 ppm when DOC and Catalytic converter is used and 332ppm when combination DPF, DOC and Catalytic Converter is used.

4. CONCLUSION

The effects of diesel engine fitted with DPF, DOC and New Catalytic Converter on engine emissions were investigated. Overall comparison of all the test runs, the least emission values were recorded when engine is loaded with sixty percent full load and having combined three aftertreatment devices including new catalytic converter. At this load, the emissions are HC is 40 ppm, CO is 0.1 %, and NO is 332 ppm. Hence, combined DPF, DOC and new catalytic converter for diesel engine provides reduction in exhaust gas emission.

5. ACKNOWLEDGEMENTS

We are thankful to Bio-energy research and quality assurance laboratory, University of Agricultural Sciences, Bangalore, India

REFERENCES

[1] Sridharan G, Chandramouli R, Mohamed MM and Ashok KT. Performance, combustion and emission characteristics of a single cylinder CI engine running on diesel-biodiesel-water emulsion with additive. Energy Sources, Part A:

[2] Recovery, Utilization, and Environmental Effects, Taylor & Francis, 2019, https://doi.org/10.1080/15567036.2019.1704948, Pages 1-14

[3] Barbara Apicella, Ezio Mancaruso, Carmela Russo, Antonio Tregrossi, Maria Maddalena Oliano, Anna Ciajolo and Bianca Maria Vaglieco, Effect of after-treatment systems on particulate matter emissions in diesel engine exhaust, Experimental Thermal and Fluid Science. 116 (2020) 110107, 1-8.

[4] V Chintala, Amit Kumar, Ashish Karn, Swapnil S. Bhurat and Ayush Kumar Mishra, Development of an after-treatment device with low cost catalysts for NOx emission reduction from diesel engines. Proceedings of 7th International and 45th National Conference on Fluid Mechanics and Fluid Power (FMFP), 2018. 1-8.

[5] S Jenoris Muthiya and Senthilkumar Pachamuthu. Electrochemical NOx reduction and oxidation of HC and PM emissions from biodiesel fuelled diesel engines using electrochemically activated cell. International Journal of Green Energy, Taylor & Francis, 2018; 15(5): 314–324.

[6] G. Elavarasan and Rajneesh Kaushal, Investigation of Metal doped-ZSM5 coated catalyst for emission reduction in a diesel engine fueled with biodiesel–diesel blends. International Journal of Ambient Energy, Taylor & Francis. 2022. https://doi.org/10.1080/01430750.2022.2056913.

[7] C Solaimuthu and P. Govindarajan. Performance Evaluation of a Urea-water Selective Catalytic Reduction (SCR) for a Diesel Engine with Mahua Bio Diesel. Energy Sources, Part A: Recovery, Utilization, and Environmental Effects. Taylor & Francis, 2015; 37(13):1424–1431.

[8] Praveen, V. Lakshmi Narayana, K. Ramanaiah. Influence of nano-additive Chlorella vulgaris microalgae biodiesel blends on the performance and emission characteristics of a DI diesel engine. International Journal of Ambient Energy, Taylor & Francis. 2020, 1-8.

[9] Harish Venu, Prabhu Appavu. Effect of nano additives in spirulina microalgae biodiesel–diesel blends in a direct injection diesel engine. International Journal of Ambient Energy, Taylor & Francis.2021, 1-9.

[10] R. V. S. Madhuri, A. Swarna Kumari, Comparative analysis on diesel engine fuelled with biodiesels blended with multi walled carbon nano tubes. International Journal of Ambient Energy. Taylor & Francis. 2021, 1-10.

[11] R. Sam Sukumar, Muralidhara Rao Maddula, A. Gopala Krishna, Experimental investigations with zinc oxide and silver doped zinc oxide nanoparticles for performance and emissions study of biodiesel blends in diesel engine. International Journal of Ambient Energy, Taylor & Francis.2013, 1-10.