ABSTRACT

Train Track Crack Classification a railway crack detection system. This paper presents the classification system that classify any crack in the railway tracks by using deep learning with convolutional neural networks (CNNs).In railway network Accidents are the major concern in terms of railway track unidentified crack in rail tracks in Indian railway. About Most of the accidents are occurring at railway track crack in railway tracks resulting in loss of precious life and loss of economy It is required to monitor the track health condition frequently using an crack classify system.

This project prevents train derailment by classify cracks in railway track using image processing technology. To propose a solution for track crack recognition that uses a combination of Convolutional Neural Network and specific image pre-processing steps. It described the innovative solution that provides efficient image processing and deep learning with convolutional neural networks.

A variety of neuron-wise and layer-wise visualization methods were applied using a CNN, trained with a publicly available from given image dataset. So, it's observed that neural networks can capture the colours and textures of lesions specific to respective cracks in train tracks, loss of precious life and loss of economy It is required to monitor the track health condition frequently using an crack which resembles human decision-making.

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LIST OF ABBREVATIONS

CNN - Convolutional Neural Networks

CRFs - Conditional Random Fields

CTC - Connectionist Temporal Classification

CTR - Collaborative Topic Regression

MLE - Maximum Likelihood Estimation

MRR - Mean Reciprocal Rank

NER - Named Entity Recognition

NERQ - Named Entity Recognition in Query

CHAPTER – 1

INTRODUCTION

1.1 Introduction

Data science is an interdisciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge and insights from structured and unstructured data, and apply knowledge and actionable insights from data across a broad range of application domains.

The term "data science" has been traced back to 1974, when Peter Naur proposed it as an alternative name for computer science. In 1996, the International Federation of Classification Societies became the first conference to specifically feature data science as a topic. However, the definition was still in flux.

The term “data science” was first coined in 2008 by D.J. Patil, and Jeff Hammerbacher, the pioneer leads of data and analytics efforts at LinkedIn and Facebook. In less than a decade, it has become one of the hottest and most trending professions in the market.

Data science is the field of study that combines domain expertise, programming skills, and knowledge of mathematics and statistics to extract meaningful insights from data.

Data science can be defined as a blend of mathematics, business acumen, tools, algorithms and machine learning techniques, all of which help us in finding out the hidden insights or patterns from raw data which can be of major use in the formation of big business decisions.

Data science is an interdisciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge and insights from structured and unstructured data, and apply knowledge and actionable insights from data across a broad range of application domains.

1.2 ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. The term may also be applied to any machine that exhibits traits associated with a human mind such as learning and problem-solving.

Artificial intelligence (AI) is intelligence demonstrated by machines, as opposed to the natural intelligence displayed by humans or animals. Leading AI textbooks define the field as the study of “intelligent agents” any system that perceives its environment and takes actions that maximize its chance of achieving its goals. Some popular accounts use the term “artificial intelligence” to describe machines that mimic “cognitive” functions that humans associate with the human mind, such as “learning” and “problem solving”, however this definition is rejected by major AI researchers.

Artificial intelligence is the simulation of human intelligence processes by machines, especially computer systems. Specific applications of AI include expert systems, natural language processing, speech recognition and machine vision.

AI applications include advanced web search engines, recommendation systems (used by Youtube, Amazon and Netflix), Understanding human speech (such as Siri or Alexa), self-driving cars (e.g. Tesla), and competing at the highest level in strategic game systems (such as chess and Go), As machines become increasingly capable, tasks considered to require “intelligence” are often removed from the definition of AI, a phenomenon known as the AI effect. For instance, optical character recognition is frequently excluded from things considered to be AI, having become a routine technology.

Artificial intelligence was founded as an academic discipline in 1956, and in the years

since has experienced several waves of optimism, followed by disappointment and the loss of funding (known as an “AI winter”), followed by new approaches, success and renewed funding. AI research has tried and discarded many different approaches during its lifetime, including simulating the brain, modeling human problem solving, formal logic, large databases of knowledge and imitating animal behavior. In the first decades of the 21st century, highly mathematical statistical machine learning has dominated the field, and this technique has proved highly successful, helping to solve many challenging problems throughout industry and academia.

The various sub-fields of AI research are centered around particular goals and the use of particular tools. The traditional goals of AI research include reasoning, knowledge representation, planning, learning, natural language processing, perception and the ability to move and manipulate objects. General intelligence (the ability to solve an arbitrary problem) is among the field’s long-term goals. To solve these problems, AI researchers use versions of search and mathematical optimization, formal logic, artificial neural networks, and methods based on statistics, probability and economics. AI also draws upon computer science, psychology, linguistics, philosophy, and many other fields.

The field was founded on the assumption that human intelligence “can be so precisely described that a machine can be made to simulate it”. This raises philosophical arguments about the mind and the ethics of creating artificial beings endowed with human-like intelligence. These issues have been explored by myth, fiction and philosophy since antiquity. Science fiction and futurology have also suggested that, with its enormous potential and power, AI may become an existential risk to humanity.

CHAPTER -2

Literature Review

2.1 Literature Review

Title : Analysis of cracking on running surface of rails

Author: Zdenka Popovic

Year : 2013

Montenegrin railways are a part of the European railway network. In the scope of realization of interoperability of the European railway system, rail infrastructure managers are required to have infrastructure subsystem maintenance plans for each conventional railway line [1]. This plan should inter alia include inspection and an appropriate strategy against the rolling contact fatigue (RCF). The rail failure or damage generally results from fatigue cracks and reduces the rail service life, increases the cost of maintenance, and may cause train derailment [2]. An increased traffic density, higher axle load and speed, as well as lubrication of rails, these are all factors that contribute to RCF and are a serious hazard to rail traffic. On the other hand, problems due to RCF can be reduced by applying an appropriate track geometry, correct wheel/ rail contact geometry, and better maintenance strategies. An adequate maintenance strategy should contribute to a longer rail service life, lower rail maintenance costs, and greater safety of railway traffic.

Title: Automatic Crack Detection and Classification Method for Subway Tunnel Safety

Author: Wenyu Zhang, Zhenjiang Zhang *, Dapeng Qi and Yun Liu

Year : 2014

Cracks are an important indicator reflecting the safety status of infrastructures. This

paper presents an automatic crack detection and classification methodology for subway tunnel safety monitoring. With the application of high-speed complementary metal-oxide-semiconductor (CMOS) industrial cameras, the tunnel surface can be captured and stored in digital images. In a next step, the local dark regions with potential crack defects are segmented from the original gray-scale images by utilizing morphological image processing techniques and thresholding operations. In the feature extraction process, we present a distance histogram based shape descriptor that effectively describes the spatial shape difference between cracks and other irrelevant objects. Along with other features, the classification results successfully remove over 90% misidentified objects. Also, compared with the original gray-scale images, over 90% of the crack length is preserved in the last output binary images. The proposed approach was tested on the safety monitoring for Beijing Subway Line 1. The experimental results revealed the rules of parameter settings and also proved that the proposed approach is effective and efficient for automatic crack detection and classification.

Title : Crack detection using image processing: A critical review and analysis

Author: Arun Mohan a, *, Sumathi Poobal

Year : 2017

Cracks on the concrete surface are one of the earliest indications of degradation of the structure which is critical for the maintenance as well the continuous exposure will lead to the severe damage to the environment. Manual inspection is the acclaimed method for the crack inspection. In the manual inspection, the sketch of the crack is prepared manually, and the conditions of the irregularities are noted. Since the manual approach completely depends on the specialist’s knowledge and experience, it lacks objectivity in the quantitative analysis. So, automatic image-based crack detection is proposed as a replacement. Literature presents different techniques to automatically identify the crack and its depth using image processing techniques. In this research, a detailed survey is conducted to identify the research challenges and the achievements till in this field. Accordingly, 50 research papers are taken related to crack detection, and those research papers are reviewed. Based on the review, analysis is provided based on the image

processing techniques, objectives, accuracy level, error level, and the image data sets. Finally, we present the various research issues which can be useful for the researchers to accomplish further research on the crack detection.

Title: Crack Detection in Concrete Tunnels Using a Gabor Filter Invariant to Rotation
Author: Roberto Medina 1, José Llamas 1 ID
Year: 2017
In this article, a system for the detection of cracks in concrete tunnel surfaces, based on image sensors, is presented. Both data acquisition and processing are covered. Linear cameras and proper lighting are used for data acquisition. The required resolution of the camera sensors and the number of cameras is discussed in terms of the crack size and the tunnel type. Data processing is done by applying a new method called Gabor filter invariant to rotation, allowing the detection of cracks in any direction. The parameter values of this filter are set by using a modified genetic algorithm based on the Differential Evolution optimization method. The detection of the pixels belonging to cracks is obtained to a balanced accuracy of 95.27%, thus improving the results of previous approaches.

Title: Automotive Crack Detection for Railway Track Using Ultrasonic Sensorz Article
Author: Sopanharith Sam, V.Ganesh
Year: 2016

In the fast developing country, people are facing many accidents; it would be undesirable for any nation to losing their life for unwanted cause. Railways are one of the important transports in India. There is a need for manual checking to detect the crack on railway track and always railway personnel takes care of this issue, even though the inspection is made regularly. Sometimes the crack may unnotice. Because of this the train accident or derailment may occur. In order to avoid this situation and automate the railway crack detection has been proposed. Here ultrasonic sensor is used to detect the crack in the