Machine Failure Prediction Using Machine Learning

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Abstract-Industrial equipment performance control and failure prediction are important not just for the quality of the produced material, but also for the amount of time and money saved in overall maintenance. This project aims to monitor the evolution of AI/ML techniques for equipment fault prediction in industries over time. The topics covered in this paper include machine learning algorithms, use cases, and principles related to the application of such technology in a variety of industries such as software and hardware. This survey looks at early research from the late 1980s to the early 2000s, as well as recent research from the early 2000s to 2017, and the most recent research from the last two years. It can be inferred that this project offers a detailed review of various machine learning and artificial intelligence (ML/AI) approaches used in the Industrial Manufacturing domain. LSTM was discovered to be one of the most commonly used processes.

1. INTRODUCTION

1.1Introduction

The quality of Internet of Things (IoT) applications [1] has improved dramatically in recent years, and related problems have become increasingly important for software developers [2, 3]. The capability of assessing the fault prediction process, evaluating the degree of a product module, and then testing [4, 5 Testing assists the developer in reducing costs, and fault detection provides input for maintenance procedures [6, 7]. At the programming process, programming weaknesses are difficult to assess [8-10]. However, finding relationships between quantifiable software properties and faults [11, 12] will aid in fault detection. Traditional approaches, such as testing or simulation, are unable to meet the challenges of fault prediction [13-15].

High cost and time overhead are two critical considerations in this regard. Furthermore, reenactment is unsuitable for promoting transient properties because it does not take into account all of the framework's potential states. A formal method can be used to solve this problem. Mathematical logic underpins formal methods. Formal methods are divided into two categories: formal specification and formal verification [16]. Formal specifications [17, 18] describe the interactions between fault proneness and formal verification. Most fault prediction papers use simulation and experiments to test their proposed system. Model testing [19-21] is another method for verifying an information-centric IoT app.

In this paper, fault behaviors are divided into two categories: dimension reduction and fault prediction, both of which can be demonstrated using behavioral models [22, 23]. Deep learning has been suggested as a result of the ongoing growth of machine learning. Deep learning uses multi-layer information processing and feature extraction to estimate complex nonlinear functions with small errors. In the literatures [11-12], convolutional neural networks and recurrent neural networks have been suggested.

In the field of deep learning, they are of practical importance. In time series prediction, recurrent neural networks are more accurate. Deep training, on the other hand, will cause the neural network's gradient to vanish. On the basis of the recurrent neural network, the long short-time memory network proposed in [13] adds three "gate" structures and has a new improvement in time series prediction with reasonably high accuracy. The performance estimation of power plant equipment is often influenced by a large number of multi-dimensional variables. When dealing with a large amount of multidimensional data, Long short-term memory networks are inefficient, and precision is sometimes lacking. Although a convolutional neural network can typically handle multi-dimensional data, the data's timing is not well reflected. Traditional particle swarms, attention systems, and other algorithms can be used to process multidimensional data, resulting in data reduction.

These approaches also neglect the relationship between input data, resulting in redundancy and data loss. This paper proposes a model based on CNN-LSTM applied to the equipment's fault prediction stage in order to find an appropriate solution. The convolutional neural network component is especially effective at data processing. It has the ability to reduce the amount of data needed for experiments. without jeopardising the data's link, the extracted feature vector is fed into a long short-term memory network that excels at forecasting time series data. This model guarantees not only the characteristics of the input data and their relationships, but also the timing of the output data.

a model Finally, the functional value, model prediction value, and LSTM network prediction value are compared. An example is used to demonstrate the method's logic and effectiveness. The approach is also shown to have a greater improvement impact than LSTM network prediction.

1.2Problem Statement

• Equipment failure due to software issues, lack of use of AI/ML techniques on existing data to predict failures, and performance deterioration of industrial equipment are some of the problems and challenges faced in this domain.

OBJECTIVE:

• In recent years, manufacturers have been looking at implementing newer machine learning approaches for predictive maintenance and equipment tracking. It is feasible to try building these sophisticated systems due to the availability and affordability of powerful computing tools, vast volumes of industrial data sets from their own plants, and deep-learning AI/ML algorithms.

2. Literature Survey

Finding faults and assigning them to the appropriate developer to fix is critical in IoT-based applications that are growing every day. The following are three key directions that previous studies [24] on IOT-based applications have taken:

1) defining and specifying metrics for calculating software complexity,

2) validating correctness and thoroughness, and

3) identifying and investigating models that attempt to predict faults based on the software metrics specified [25, 26].

Software metrics, which provide quantitative images of programme qualities, can be used to describe fault prediction in software. Several studies show that programme metrics are linked to fault proneness [27]. To construct predictive models of the future, a few techniques have been investigated. Computer fault prediction Statistical methods [28] have also been proposed. Much research has gone into determining the best way to choose programme metrics that will most likely reveal fault-proneness [29]. Some metrics for describing software quality in static and dynamic platforms have been introduced. The features of code structure are calculated as metrics in the static platform [30]. A number of supervisors [31, 32] and a number of bunches [33] are static measurements. Testing perfectionism is measured using dynamic platforms. Basic element measurements are influenced by the spectrum of auxiliary and information streams [6]. The relationship between product measurements and blame proclivity, as well as a number of quantifiable programming characteristics, has been precisely defined. Many researchers have demonstrated this [22, 34-37]. Assurance of fault prediction modules is important since it defines the modules require itemized testing and replication [38]. Measurements are used in early fault prediction algorithms [39]. Machine learning techniques [40], such as Support Vector Machine (SVM) [41], have gained a lot of attention recently.

Artificial Neural Network (ANN) [42] and Naive Bayes algorithm (NB) [22]. The Multi-Layer Perceptron (MLP) is a common supervised learning machine learning algorithm. The Particle Swarm Optimization (PSO) algorithm is an optimization algorithm that uses evolutionary algorithms. Rui et al. [43] suggested a fault detection system for power IoT devices.

Via deep learning, they proposed a multi-spectral approach for fusing images. A deep learning convolutional neural network is used to detect faults in images of power devices. Their proposed method aids in the accurate and fast location of fault points. [44] suggests a hybrid solution incorporating the Extreme Learning Process (ELM) and the Genetic Algorithm (GA). With extracting useful information from the fault reports, a vector space model is constructed based on the information and a minimal feature set is selected. The features are fed into an ensemble classifier that is a GA-based ELM training algorithm. Their proposed algorithm outperformed KNN, Naïve Bayes and SVM. Another issue in IoT environments is occurring computer defects as a result of ageing A tool for predicting software ageing was proposed by Liu and Meng [45]. The approach is based on a Back Propagation (BP) error neural network. The Artificial Bee Colony (ABC) algorithm is used to determine the weights and thresholds. To put it another way, ABC is used to improve the BP model. They demonstrated that, when compared to the conventional BP neural network, their proposed approach converges more quickly and accurately predicts.

3. OVERVIEW OF THE SYSTEM

In systems engineering, information systems, and software engineering, the Systems Development Life Cycle (SDLC) is the process of developing or altering systems, as well as the models and methodologies that people use to build these systems. The SDLC definition underpins a number of software development methodologies in software engineering.

3.1 Existing System

- The following are three key paths that previous studies on IoT-based applications have taken: 1) identifying and determining metrics for measuring machine complexity, 2) validating correctness and thoroughness Some metrics for describing software quality in static and dynamic platforms have been presented. The features of code structure are calculated as metrics in the static platform. A number of supervisors and a number of bunches are used in static calculations. Testing perfectionism is measured using dynamic platforms. Measurements of basic elements are based on scope of auxiliary and information sources Many researchers have demonstrated the connection between product measurements and blame tendency, as well as numerous quantifiable programming characteristics.

3.1.1 Disadvantages of Existing System

- For the dimensionality process and prediction approach, existing methods are used.
- Existing approaches are focused on research protocols that can't predict abrupt data changes.

3.1.2 Proposed System

- Identify potential computer failure early and warn the device. The approach is to use a Deep Learning LSTM model to forecast time series values in advance, and then use a classifier to assess whether or not to issue an alert.
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- In this proposed scheme, the LSTM algorithm is used to create a model from a data set of an equipment. Values are trained using a machine learning model, which is then used to track fault detection and generate warnings.

3.1.3 Advantages of Proposed System

- Machine learning methods are used to detect faults in automated machinery processes.
- There is no need for manual intervention or checking.
- Processing time is cut in half.

3.2 System Modules

Dataset Collection:

Machine data set with one feature and one label is used in this dataset. Feature with memory and label with o and 1 are used as dataset in this project.

Pre-processing:

In this stage data set features are taken as input and difference in time series data is calculated and new dataset is created which has difference values with previous values. This dataset is used for predicting next values based on difference as feature and next value as label.

Prediction Model:

LSTM model is initialized for training time series data. Using fitting function features and labels are given as input and algorithm model is trained for predicting future values.

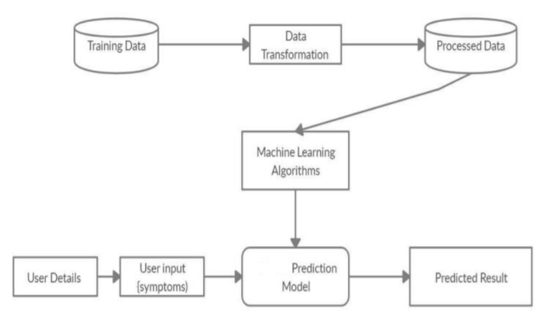
Regression Model:

In this module data set with memory values are used as features and alert or non-alert is used as label. And model is trained and this model is used for prediction failure condition.

Prediction:

For prediction new dataset is taken with 100 memory values as features and given input for predict function of LSTM model and linear regression model and next value and failure prediction value is calculated.

ARCHITECTURE:



4. CONCLUSION

A short-term prediction approach based on the LSTM network is proposed in this project, based on existing fault predicting technologies. This approach increases the accuracy of fault detection as compared to the CNN method. The benefit of this approach is that it can predict the next value. System malfunction is predicted and a warning is displayed by comparing previous dataset values and based on the next value using a Logistic regression classifier.

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