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Fault Detection Using Machine Learning Of Electrical Vehicle

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Abstract: In industrial and automotive electric drives, the main components are an electric motor and a power electronics-based inverter. We describe a model-based fault diagnosis system in this research machine learning technology was used to design a system for identifying and detecting many types of defects in an electric system drive. From a hardware failure point of view, the weakest link in such a system is as a result, the focus of this study is on detecting and locating flaws [1].

The aim of this work is to show how to detect defects in an electromechanical conversion chain for traditional or autonomous electric vehicles. EVs are feasible to operate the information and data collected by several sensors to recover a sequence of data such as currents, voltages, and speeds, and so on. Using the characteristics extraction technique, create an architecture for a fault detection model. The long short-term memory (LSTM) technique for fault detection is displayed in this regard. This method has been used to build an electric vehicle prototype and has shown to be more accurate than other methods [2].

This article describes a fault detection technique based on machine learning (ML) that can help maintenance assistants in discovering defects in induction machine power connections. The system has been built to handle not only single phasing failures but also opposing wiring connections. As field data in default, in an industry where defective incidents are rare, a simulation-driven ML-based fault detection system could be useful. As a result, the ML algorithm's training data is now available. To train the machine learning models, developed using Software-in-the-Loop simulations [3].

Keywords: Vibration sensor, Voltage Sensor, Current Sensor, DHT11 Humidity Sensor and Temperature Sensor, Arduino Nano, LCD Display, Relay,

1.INTRODUCTION

Because of the extensive usage of electric vehicles (EVs) and the increase of electricity generation, smart city control is getting more complex. Due to their environmental benefits, EVs can be considered future individual and public transportation. They have a decarbonisation feature. In comparison to conventional vehicles, electric vehicles are more energy efficient. Gasoline or diesel powered vehicles.

EVs can be treated in the long run. As energy storage devices, opening up new possibilities and supplementary services for micro grids in the form of voltage regulation, frequency regulation, and so on V2G technology (vehicle-to-grid). Faults in micro grid components such as electric vehicles and distributed energy resources is unavoidable[4].

Electric vehicles have a number of electrical components and energy conversion chains. To get the most out of them A fault detection (FD) approach must be used over the course of a lifetime. During the Multiple sensors, the probability approach, the algorithmic approach, artificial intelligence (AI), and machine deep learning have all been mentioned in the FD has been proposed in the literary texts. These methods can even be utilized at the same time. An FD is a financial director. Strategy has quickly evolved into a viable alternative to standard health care[5].

Induction in three phases Motors that produce exact torque utilizing techniques like Field Oriented Control (FOC) are widely utilized in a variety of industrial applications, including the aerospace industry. For electric and hybrid vehicles, automotive powertrains are available. The Solid state electronics are used to control these drives. reference voltage is set in response to a control algorithm. The voltage reference is established and the inverter is created.

Command utilizing pulse-width modulation techniques PWM (pulse width modulation) or SVM (space vector modulation). If a switch is flipped on, when it doesn't work the way it's supposed to the voltage[6].

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2.VIBRATION SENSOR

Fig-Vibration sensor

This module has an adjustable potentiometer, a vibration sensor, and an LM393comparator chip that produces a variable digital output based on the amount of vibration. The sensitivity of the potentiometer can be increased or decreased to the appropriate level. When the module is triggered, it outputs a logic level high (VCC), and when it isn't, it generates a logic level low (GND). In addition, when the module is triggered, an integrated LED illuminates[7].
Features:

- The switch's default state is closed.
- Output in digital format Voltage range: 3.3V to 5V
- The results are shown on an on-board indicator LED.
- Sensor based on the on-board LM393 chip SW-420, typically closed type vibration sensor
- The board's dimensions are 3.2cm by 1.4cm

Vibration level measurement may be used to produce a variety of applications, however precisely sensing vibration is a challenging task. This article discusses the vibration sensor SW-420 and the Arduino interface, which may assist you in designing vibration measurements that require less work. A breakout board with a comparator LM 393 is included with the vibration sensor SW-420, an adjustable on-board potentiometer for setting the sensitivity threshold, and a signal LED indicator. This sensor module generates logic states in response to vibration and external force. This module outputs logic LOW when there is no vibration. When this module detects vibration, the output is set to logic HIGH. This circuit's working bias ranges from 3.3 to 5 volts DC[8].

3.VOLTAGE SENSOR-

Fig-voltage sensor

This module uses the resistor divider method to lower the input voltage of the terminal interface by five times.
The Arduino's maximum input voltage is 5V. The voltage detection module's input voltage cannot exceed 5V (5 = 25V) (if 3.3V is used) The input voltage cannot exceed 3.3Vx5 = 16.5V in this system). Because the AVR chip used by Arduino is 10-bit AD, this module's analogue resolution is 0.00489V (5V/1023), hence the voltage detection module detects 0.00489V5=0.02445V as the input minimum voltage. Parameter: Maximum input voltage range: DC0-25V DC0.02445V – 25V voltage detection range
0.00489V is the voltage simulation resolution[9].
DC input interface: terminal positive terminal is connected to VCC, negative terminal is connected to GND Voltage simulation resolution: 0.00489V The "+" pin is connected to 5/3.3V, the "-" pin is connected to GND, and the "s" pin is connected to the Arduino's A0 pin..

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4.CURRENT SENSOR-

Fig-current sensor

When current runs through a conductor, a voltage drop occurs. Ohms law describes the relationship between current and voltage. In electronic devices, an increase in current beyond what is required causes overload, which can harm the device. Current measurement is required for the proper operation of equipment. Voltage measurement is a passive operation that can be performed without influencing the system. Measurement of current, on the other hand, is an intrusive activity that cannot be noticed directly as voltage. In order to detect current in a circuit, a sensor is necessary. Without affecting the system's performance, The ACS712 Current Sensor can be used to compute and measure the amount of current flowing through a conductor[10].

The ACS712 Current Sensor is a fully integrated linear sensor IC based on the Hall effect. This IC has a low resistance current conductor and a 2.1 kV RMS voltage isolation. The ACS712 Current Sensor offers a wide range of applications because it can detect both AC and DC current. Peak detection circuits, circuits to enhance gain, rectification application for A to D converters, Overcurrent fault latch, and more applications use ACS712. This IC's filter pin is utilized in resistor divider circuits to eliminate the attenuation effect. ACS712 is used in a variety of industrial, commercial, and communication applications. This IC can be used in automotive applications. Motor control circuits, load detection and management, and SMPS are just a few of the common uses for this IC[11].

5.DHT11 HUMIDITY SENSOR AND TEMPERATURE SENSOR-

Fig-DHT11 humidity sensor and temperature sensor

The DHT11 digital temperature and humidity sensor is a low-cost option. This sensor may simply be connected to any microcontroller, such as an Arduino or a Raspberry Pi, to measure humidity and temperature in real time. The DHT11 humidity and temperature sensor comes in two versions: a sensor and a module. The pull-up resistor and a power-on LED distinguish this sensor from the module. A relative humidity sensor is the DHT11. This sensor employs a thermistor and a capacitive humidity sensor to measure the ambient air. A capacitive humidity detecting element and a thermistor for temperature detection make up the DHT11 sensor. A moisture-holding substrate serves as a dielectric between the two electrodes of the humidity sensor capacitor.

With changes in humidity levels, the capacitance value changes. The IC measures, processes, and converts the resistance values into digital form. This sensor employs a Negative Temperature Coefficient Thermistor to measure temperature, which causes the resistance value to drop as the temperature rises. This sensor is commonly built of semiconductor ceramics or polymers to get a higher resistance value even for the smallest change in temperature. DHT11 has a temperature range of 0 to 50 degrees Celsius with a 2-degree accuracy. This sensor's humidity range is 20 to 80 percent, with a 5% accuracy. This sensor has a sampling rate of 1Hz, which means it takes one reading per second[12].

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6.ARDUINO NANO-

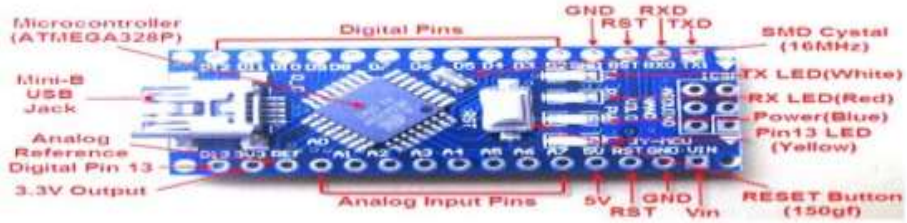

Fig-Arduino Nano

The Arduino Nano is a microcontroller board based on the ATmega328p that is compact, complete, versatile, and breadboard friendly. It was created by Arduino.cc in Italy in 2008 and contains 30 male I/O headers configured in the DIP30 style. The Arduino IDE, which can be downloaded from the Arduino website, is The Arduino Nano has 14 digital pins, 8 analogue pins, 2 reset pins, and 6 power pins used to program it. The Arduino Nano is basically a smaller version of the Arduino UNO, and the two boards have nearly identical functionality. It operates at 5 volts, although the input voltage can be anywhere between 7 and 12 volts. The Arduino Nano's maximum current rating is 40mA, therefore any load attached to its pins should not draw more than that[13].

Each of these Digital & Analog Pins has numerous functions assigned to it, but their primary function is to be configured as Input/Output. When you link Arduino Pins with sensors, they work as Input Pins, but when you're driving a load, you'll need to use them as Output Pins. Digital pins are controlled by functions like pin Mode () and digital Write (), while analogue pins are controlled by analog Read (). The analogue pins have a total resolution of 10-bits and can measure voltages ranging from 0 to 5V. The Arduino Nano has a crystal oscillator with a frequency of 16 M Hz. It's utilized to make a clock with a precise frequency by employing a continuous voltage source[14].

7.LCD DISPLAY-

Fig-LCD display

A liquid crystal display is a flat-panel display or optical device that makes use of liquid crystal's light modulating characteristics. LCDs do not directly emit light; instead, they use a background illumination or reflector to produce shading or monochromatic images. Computer monitors, televisions, instrument panels, aircraft displays, and indoor and outdoor signage are all examples of LCD applications. Mobile phones with small LCD screens, including smart phones[15].

8.RELAY-

Fig-Relay

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Main features of the relay-

- Despite its small size, 10A switching capacity is available for high density p.c. bora mounting techniques.
- UL, CUL, and TUV certifications are available.
- Plastic material selection for high temperatures and improved performance
- Performance of a chemical solution
- Types that are sealed are in stock.
- To meet the cheap cost of mass production, a simple relay magnetic circuit was created.

9.RESULT-

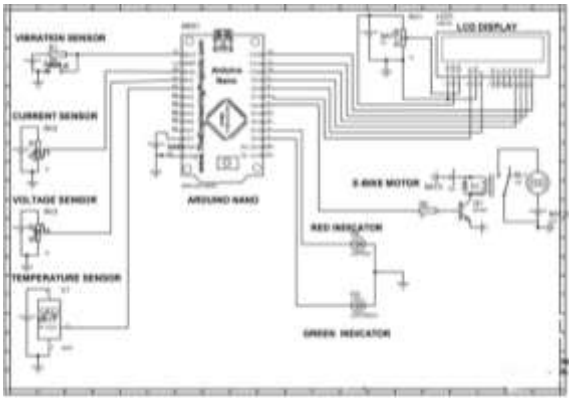

Fig-Result simulation

When the battery is connected to the LCD display, the Arduino, and other components of the systems, and the vehicle is in normal operating condition, that is, there is no fault in the electric vehicle, the green light indicates and the LCD display shows the vehicle is ON notification whenever a fault occurs, such as any excessive vibration in the electrical vehicle; any short circuit current and an increase in current value over the rated value; any increase or decrease in voltage of the vehicle. Then, using Arduino Nano algorithms, all of the faults above are detected by the sensors, and the relay coil is instructed to break the supply to the faulty section, resulting in the vehicle being turned off and the red indicator turning on in the LCD display[16].

10.ADVANTAGES-

1. This helps to expand the business.
2. Improve reliability of system, which promotes the uses of electric vehicles powertrain.
3. Helps to get EV characteristics and design parameters such as motor power, EV performance ,battery power, torque- speed characteristics ,driving range, and change / discharge ,which is the necessity for the
4. Design and sizing selection of the main EV component.

11.CONCLUSION-

Approaches based on deep learning have been widely applied in a variety of applications. However, five important electrical applications were examined for review in this work. A detailed analysis of DL techniques to handling electrical problems such as insulator fault identification, power line inspection, PV panel hot spot detection, Bearings fault diagnosis, and fuel efficiency optimization in EVs is discussed in this paper. DL has proven to be extremely useful in a variety of sectors. We studied the key state-of-the-art architectures and conducted a comparative analysis of them. An attempt has been made to present a state-of-the-art evaluation of literature relating to five significant concerns in the electrical industry. This will help researchers who are interested in a certain area of this field[17].

This research can be used to other electrical fault diagnoses as well. Infrequent applications of the DL algorithm have recently been made, including wastewater management, breast cancer screening, and other non-electrical applications. As a result, the authors would like to expand1, 2, 3, and placed before the below sections.on this review in the future to look at the more unusual applications of DL algorithms. This will provide an overview of the numerous applications of DL, assisting researchers in applying DL algorithms in a broader context. The progress in DL has primarily been made through examining many variants of architectures that have already been described in the literature. These variants are only tested in the lab and do not have a practical approach.

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Hence it becomes a situation that is far from reality at present[18].

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