Machine Learning Method Based Industrial Risk Analysis and Prediction

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Machine Learning Method Based Industrial Risk Analysis and Prediction

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ABSTRACT

IoT-based technologies growing all over the world. After the industrial revolution, machines and robots gradually replaced human effort. In the absence of the human brain-machine and robots makes an error. In this paper, a plan was developed to get out of this situation that works not only efficiently but also thinks like humans. In this system, the machine will learn based on the situation that has been made by any occurrence. In this work Raspberry Pi-based system helps to make a proper analysis of the machines. Voltage, current, gas value, and temperate values are taken as input parameters. Machine learning matches/compares these real-time sensor data with training data (which is used to train the system). As a result, The machine learning module provides some statistics graphs of sensor data. Machine performance can analyze by observing these graphs. Also, determine the efficiency and predict the possibility of upcoming threats or risks.

CCS CONCEPTS

• **Computing methodologies** → Machine learning; Learning paradigms; Supervised learning; Supervised learning by regression; • **Hardware** → Communication hardware, interfaces and storage; Sensor devices and platforms; • **Information systems** → Data management systems; Database design and models; Relational database model; • **Mathematics of computing** → Probability and statistics; Statistical paradigms; Statistical graphics; • **Software and its engineering** → Software notations and tools; Context specific languages; API languages.

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KEYWORDS

IoT, Industrial revolution, Raspberry pi, Machine Learning, Statistics graph, Predicts

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1 INTRODUCTION

New technologies arise day by day. Recently, Industrial automation systems have become popular because of the Internet of Things (IoT). IoT is used to do real-time monitoring, real-time data collection, and real-time control systems, among other things. Industrial machines can control remotely by using IoT. Any industry can benefit from the Industrial Internet of Things (IIoT) by boosting productivity and efficiency, but climate action should be a top priority [1]. One of the major problems is the industrial system damage. Industrial Equipment damage sometimes depends on climate parameters such as temperature, humidity, etc. Because of damages, they need to bear huge losses [2]. One component will harm before overall system damage. If we detect this problem before the whole system is damaged and overcome it. We can save a significant loss. Machine learning can analyze Industrial data and provide prediction by analysis of data [2].

Machine Learning is a field that is fast-moving and incredibly popular. Machine learning is a subset of Artificial Intelligence (AI) that can enable software to learn automatically from datasets progress, and execute a particular task using data without becoming a specific program [3]. It has helped the concept of artificial intelligence achieve a tipping point [3]. Machine learning plays a vital role in industrial automation by analyzing industrial data, classifying the data, and creating ideas [3] [4]. Those ideas can use to make effective decisions and forecast the future [4]. It generates real-time results without any need for human involvement using training data analysis. It develops data-driven models to make it

easier to evaluate and interpret enormous amounts of data [4]. Machine Learning has evolved into a quick and effective approach for businesses to construct models and strategize plans [4]. Manufacturers can benefit from machine learning (ML) in many ways, including optimization, maintenance prediction, recommendation, and many more [3].

As per Federal Trade Commission's figures, more than 388,588 cases of abuse were reported in 2019, resulting in $1.9 billion US dollars in losses [5]. "An approximately $62 billion is lost by U.S.businesses each year due to unsatisfactory consumer interactions", as shown by New Voice Media research [6]. In recent years, online travel sales have increased quickly. It reached $564.87 billion in 2016. By 2020, the figure is predicted to rise to $817.54 billion. Because of, recent technological advancements [7]. Albert is exclusively found on Harley Davidson motorcycles. The organization looked at consumer information to see what prior consumers did that was favorable. Albert used this information to construct client categories and scale up the test marketing strategy accordingly. According to the results, Albert boosted Harley Davidson's sales by 40% [8]. The company also saw a 2,930 percent rise in leads, with half of those coming because of artificial intelligence and machine learning [8].

We will show our overall proposed system in figure 1. We proposed an industrial automation system which is including with Machine Learning. We used some parameters such as temperature, humidity, gas leakage, current, voltage, etc. Now, we trained our model using training data of those parameters. We collect training data from industries. We used Raspberry pi 3 B+ to implement our system. From our system, we collect testing data and send these data to our database. Then, the Machine learning module gets testing data from the database called Application Programming Interface (API). As a result, our system will generate a probability graph of testing value by comparing or matching training data. By analyzing this graph, we can see our desired prediction. We can see it in the android app. Figure 1 is given below:

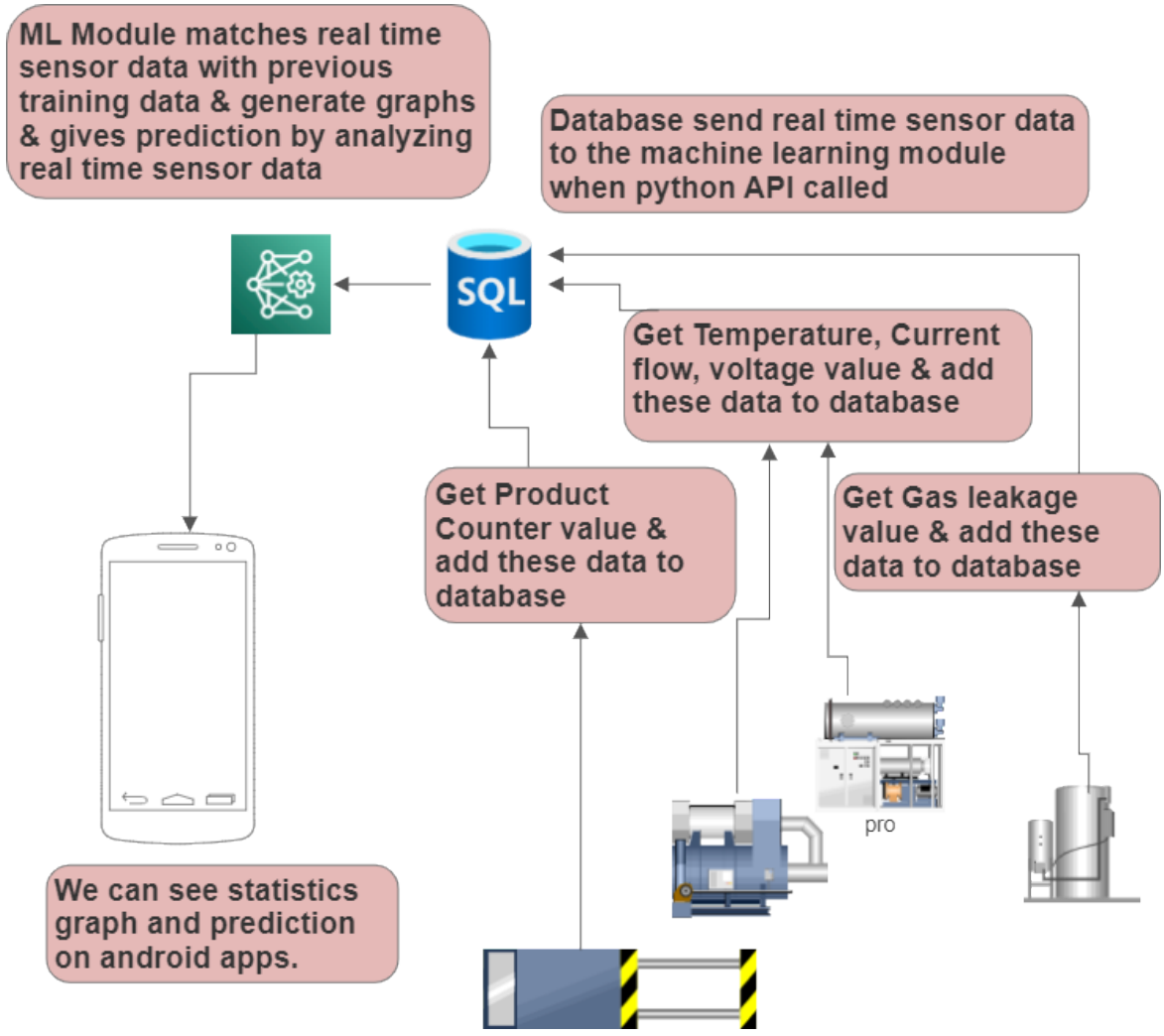

Figure 1: Overall Proposed System

2 PREVIOUS WORK

Q. Mina, Y. Lua, Z. Liu, Chao Sua, and Bo Wangc proposed"Machine Learning-based Digital Twin Framework for Production Optimization in Petrochemical Industry". The limitation is: The unit's optimum yield does not always represent the highest total economic gain; it must also take into account the consequences of energy consumption, market fluctuations, and other lower yields [9]. **S. Pandita** proposed "IOT BASED INDUSTRY AUTOMATION USING RASPBERRY PI".

Challenges of a given system, sensors are generally battery-powered and wireless, and collecting data from sensors (things) is considerably more cost-effective than ever before [10]. **Kavitha. B.C, Vallikannu. R** proposed an "IoT Based Intelligent Industry Monitoring System".This system makes use of a Raspberry Pi to provide low-cost security solutions. The proposed technology has applications in manufacturing as well as monitoring vehicle-related pollution [1]. **Sushrut Nagesh Kulkarni and Sanjay Kumar Singh** designed "Object Sorting Automated System using Raspberry Pi". The benefits of this system are: The color and shape of the object were almost always correctly detected after executing the image processing routines [11]. The major disadvantages of this system are that poor or dim lighting around the object can lead to incorrect detection in the case of shape. **Bjorn Kroll, David Schaffranek, Sebastian Schriegel, and Oliver Niggemann** proposed "System modeling based on machine learning for anomaly detection and predictive maintenance in industrial plants". This paper describes a method for predictive maintenance of industrial plants that employ timed hybrid automata of the machine's regular behavior [12]. Discrete and continuous signals are reduced to individual states in this hybrid paradigm. The noise handling between simply mechanically driven operations and cycle-based data collecting is one of the issues while acquiring data [12].

3 SYSTEM OVERVIEW

We used Raspberry pi 3 B+, DHT11 sensor, MQ-2 gas sensor, LM35 sensor, INA219 sensor, Ultrasonic sonar sensor, LCD, etc. in our system. These Sensors sense the parameters of temperature, humidity, current, voltage, etc. around our system.

We can control our system over the Internet that's why we may call it the Internet of Things (IoT).In our system, all sensors collect real-time data. These sensors collect data on temperature, humidity, current, voltage, etc. We can see this data in our LCD. Now, t h e Sensors send data to the raspberry pi 3. Raspberry pi 3 sends these data to our MySQL database. Our database will filter and remove invalid data before storing these data. Our database sends these data to the machine learning module when the python Application Programming Interface (API) will be called. These data will be used in the Machine learning Module as testing data. Finally, our machine learning module generates a probability graph of these data. From this graph, we can see our desired prediction which is shown in the result section. We implemented the proposed system which is shown in figure 2.

Figure 2 shows the top view of the entire system. From figure 2, we can see the whole environment of this system.

Overall connections of our system are shown in Figure 3. How sensors are connected with Raspberry Pi 3 GPIO pins and Raspberry pi gets power from Laptop are shown in figure 3. Figure 3 is given below:

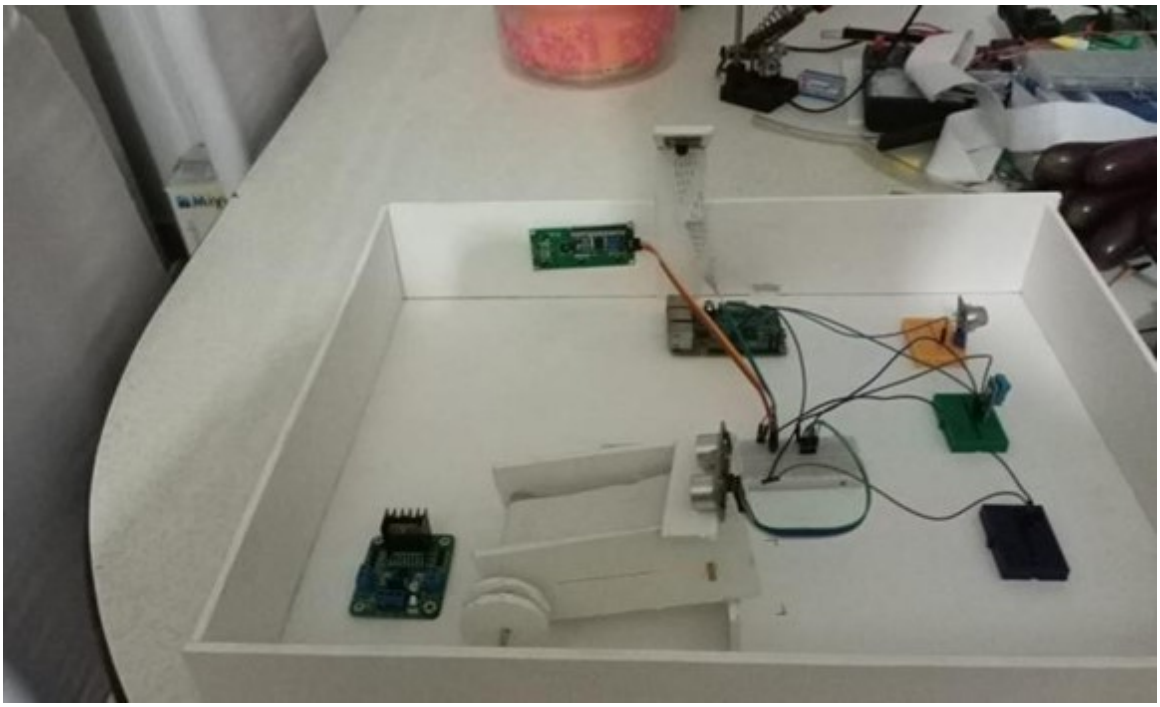

Figure 2: Top view of entire system

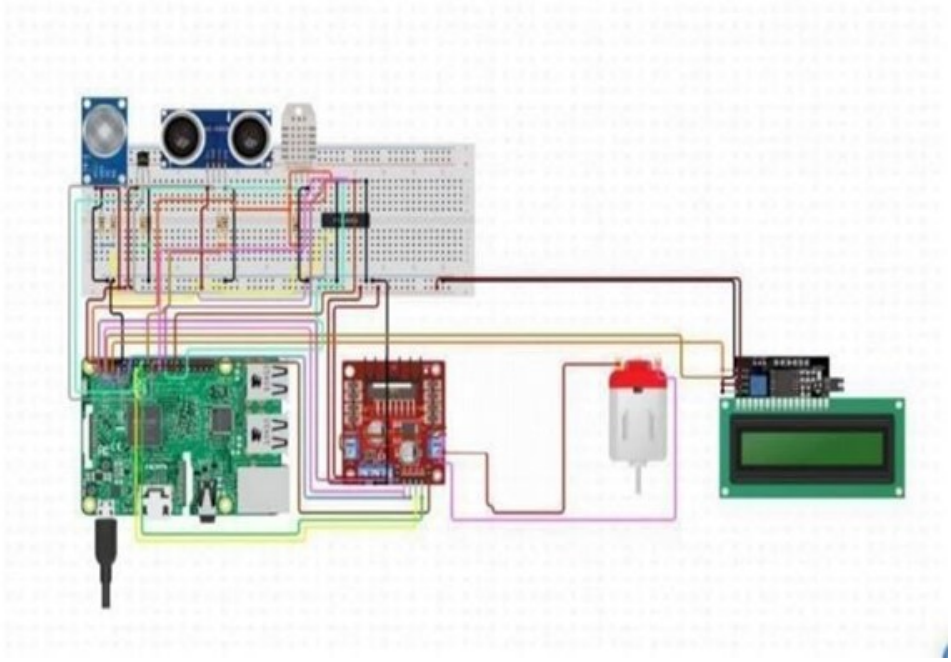

Figure 3: Overall Connection

4 HARDWARE DESCRIPTION

In our project, we used a few components such as Raspberry pi 3, DHT11 sensors, MQ2 gas sensors, LM35 sensor, and Ultrasonic Sonar sensor. Now, descriptions of all components are given below:

4.1 Raspberry pi 3 B+:

Raspberry pi 3 is a small-size computer. It was developed based on ARM architecture. It used Linux operating system. Raspberry pi 3 can be used in IoT, automation, and robotics system. It has 28 GPIO pins out of 40. We used Raspberry pi 3 B+ in our project. In our project, Raspberry pi is connected with sensors and LCD. It collects real data from sensors. We can see these data in LCD. Raspberry pi transfers these data to our database [13]. These data are used as testing data in our machine learning module. We used a laptop to put the power supply in Raspberry pi. We used RDP or Remote desktop connection to control our Raspberry pi using an Internet IP address.

4.2 MQ2 sensor:

It is an electric sensor that can be used for gas leakage detection or measuring the presence of gas. It is suitable for sensing LPG, CH4, CO, Smoke, etc. it also detects Alcohol too. This sensor used is in many important real-life projects. This sensor has a potentiometer to adjust its sensitivity of this sensor. We used this sensor in our project to detect gas leakage and Smoke.

4.3 DHT11 sensor:

Humidity in manufacturing environments can influence product costs and staff health and safety. DHT11 is a sensor that is used to measure temperature and humidity. It is a digital sensor. To measure neighboring air quality, this sensor uses a capacitive humidity sensor and a thermistor. We used this sensor to measure air humidity and temperature.

4.4 LM35 Sensor:

LM35 sensor is an integrated circuit temperature sensor that is used to measure board temperature. It is similar to transistors such as T0-42, and T0-92. Because, LM35 also has 3 pins VCC, Output, and Ground. We don't need to do the external calibration. LM35 provides electrical output voltage. We used this sensor to measure our project board temperature.

4.5 INA219 Sensor:

INA219 is a sensor that can be used to measure the current, and voltage across the shunt resistor. It also measures power. This sensor is connected with IIC (Inter-integrated circuit) for transferring data to the microcontroller. We used this sensor to measure shunt current, and shunt voltage.

4.6 Product Counter:

We made our Product counter using an ultrasonic sonar sensor, DC motor with the motor controller, an extra 5v power supply, and a conveyor belt. We used an ultrasonic sonar sensor to count products by using ultrasonic sound waves. It has a transmitter and receiver to transmit and receive sound waves. It counts how many times an object passes in front of it. It has 4 pins. These are VCC, Trigger, Echo, and Ground. We used a DC motor and motor controller to make our counter automate. We used an extra 5v power supply. Because Raspberry pi 3 can't able to handle the motor [13].

5 METHODOLOGY

We used a few techniques in our system. First of all, we designed and implement an IoT device using some sensors and Raspberry pi 3. Then, we used sensors value in the machine learning module as testing data. We used the linear regression method to get predictions for sensor values. The linear regression technique is described below:

We used Linear Regression Machine Learning Model in our system. Linear Regression is a supervised machine learning types algorithm. That is used to make predictions of testing data based on previous experience. It makes a linear relationship between dependent and independent variables. Linear Regression can be expressed as:

$$y = m + nx$$

Here, x is said to be an independent variable or predictor value. In our model, x is known as a testing value means our sensor value. Y is a dependent or response variable that will be our outcome. Also, '**m**' means the slope of a line, and '**n**' means y-intercept. The slope and intercept indicate the line's look or steepness and location. It can use to analyze the average rate of change. In the linear regression method, we were needed to train our model to make the prediction. We used almost 10,000 training datasets to train this system. We collected these data from industries.

We make a flow chart for our project. This flow chart is given as well as described below.

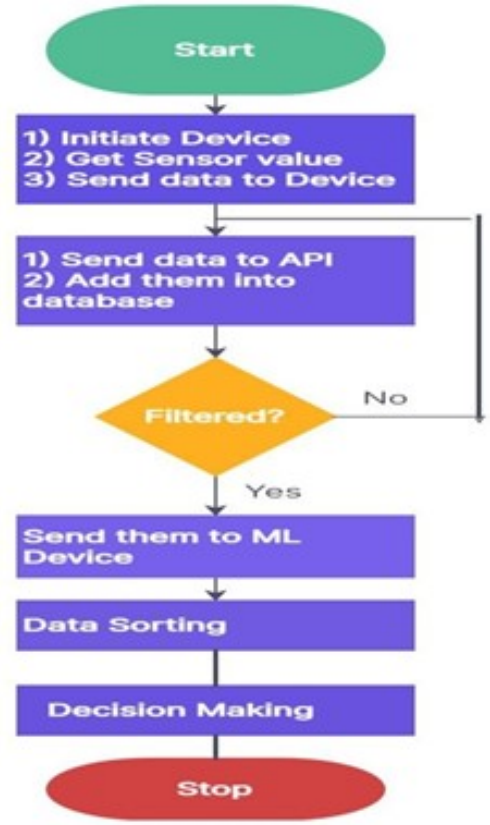

Figure 4: Flow Chart

Figure 4 shows the Flow chart of our overall system. We will describe the flow chart in the Algorithm part. The Algorithm of our system is described below:

1. Firstly, we collected the data from the sensor and send them to our raspberry pi.
2. We are controlling our raspberry pi using a Remote Desktop connection based on a secure shell (SSH).
3. Now after receiving the data from the sensor our raspberry pi sends them to our remote Application Programming Interface (API).
4. We set our MySQL database. We insert the data based on the system filtering and validation.
5. Now, after data collection, we send them to the machine learning section using the system Cron job, also known as Scheduled Tasks. There we match our data on behalf of system observation.
6. After machine learning module calculation, we get the proper output Graph.

We made our system using linear regression of the machine learning technique and follow every step of the given flow chart. After completing, we test our system and got some results. These results are given in the result section.

6 RESULT

In this section, we will show the outcome. Our outcomes are given:

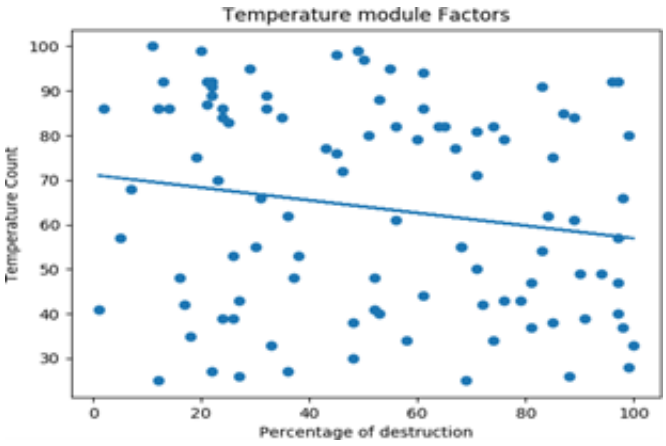

Figure 5: Linear Regression Output

In Figure 5, We show the linear relationship between temperature vs percentage of destruction based on our training data. When we give sensor data as testing data the system will return the predicted value across training data. In the given graph if we give any certain temperatures as reference testing data system will predict the possible destruction Some results for real-time sensor data are given below:

Figure 6 shows the last 4 days of voltage data. This figure tells the voltage supply is 5kV per hour in our system with 89% efficiency. It also shows, No upcoming threat in our system with this voltage supply ratio.

Figure 7 shows the last 4 days of current data. Figure 7 tells the current flow is 25Amp per hour in our system with 72% efficiency.

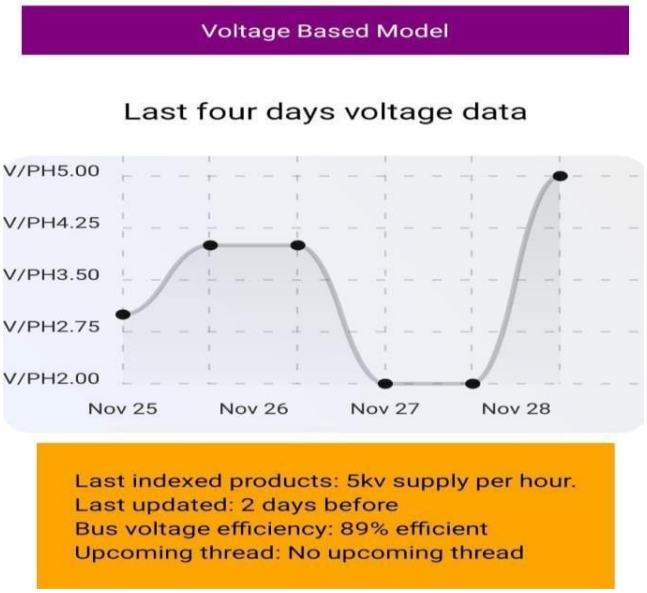

Figure 6: Voltage Based Model

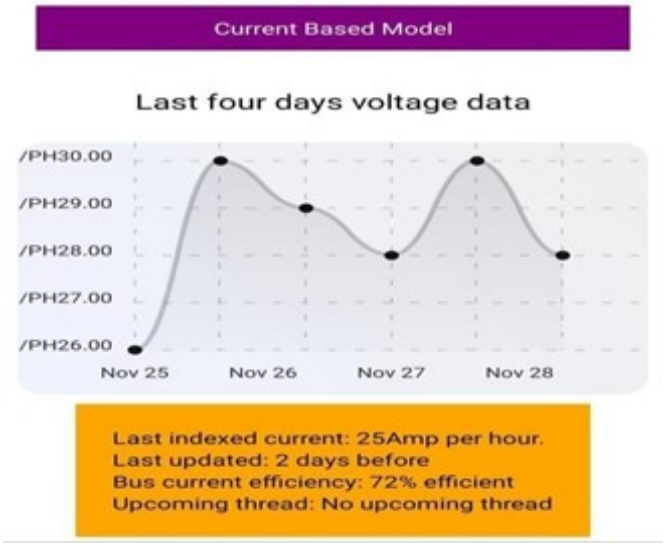

Figure 7: Current Based Model

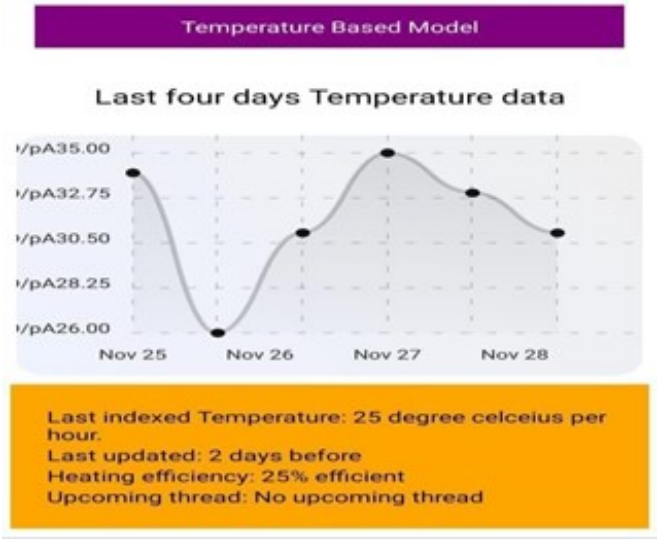

Figure 8: Temperature Based Model

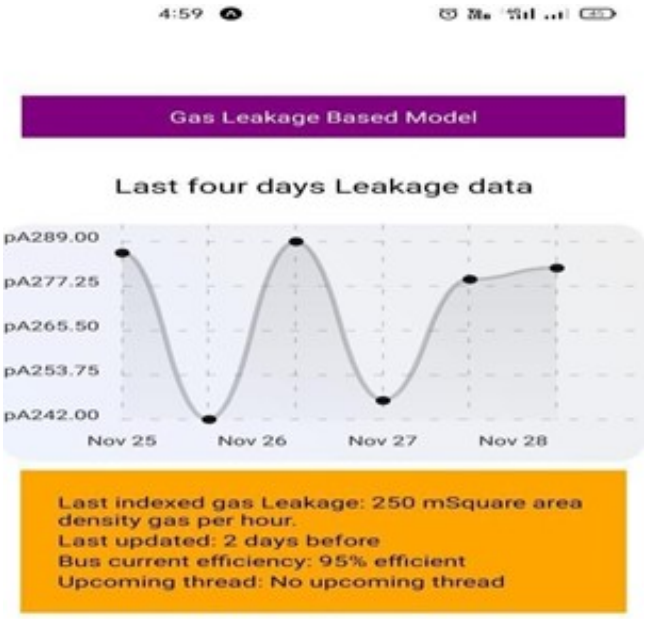

Figure 9: Gas Leakage Based Model

It also shows, No upcoming threat in our system with this current flow ratio.

We have shown the last 4 day's temperature data from the sensor in Figure 8. We can see the temperature is 25 degrees Celsius per hour with 25% heating efficiency in our system. Heating efficiency is low because sensors take normal room temperature data. It also shows, No upcoming threat in our system with this temperature ratio.

Figure 9 shows the last 4 days of gas leakage data in our system. Figure 9 tells gas leakage is 250 per mSquare area in our system with 95% efficiency. It also shows, No upcoming threat in our system with this gas leakage ratio.

In Figure 10, we show the last 4 days' product counter data. From Figure 10, the product counter count is 56 products per hour with 76% efficiency. It also shows, No upcoming threat in the product counter unit.

Machine Learning predicts the possibility of an upcoming threat by analyzing facts such as current overflow or not, low or high voltage supply, high temperature or low, etc.

Figure 10: Product Counter Model

7 DISCUSSION

This project has been developed using machine learning for the purpose of industrial risk analysis. Using this system, an industry can save huge losses by analyzing upcoming threats to industrial components before occurs. Industry can benefit by saving time and money by implementing our proposed system. This system can be more advanced by adding an upcoming threads prevention system.

8 CONCLUSION

We've produced a unique and useful device using machine learning and the Raspberry Pi. The technology we've created is a one-of-a-kind automation system that's different and more efficient than prior or traditional static automation systems. Our system will be more automated and less reliant on humans. Our system thinks like a person, so we don't have to teach it anything, and this is where our machine learning notion begins. Our system will think and forecast like a human. We are having some challenges with our job. Because of the time delay problem, data cannot be transferred often to the server, and also, the Raspberry Pi can't read analog input. We were able to solve this problem.

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