INDUSTRIAL AUTOMATION USING LoRa

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ABSTRACT

Modern Monitoring and Control is vital for gather all the significant data, measurements, and information connected with the different modern cycles, engines, machines, and gadgets utilized in modern premises. This focuses on controlled admittance with improved efficiency. Nonetheless, these remote correspondence strategies are by and largelimited to basic applications on account of their sluggish correspondence paces, distances, and information security. Another arrangement is embraced for the conventional observing and controls of Industrial applications through the execution of LoRa using high-quality communication and high security. Here LoRa is used to transfer the data that is monitored and controlled. The data can be seen in the control unit and also the manufacturing unit. To make it better clearwe have uploaded the data in thingspeak for graphical representation and also in a mobile application. We havedeveloped the code to check the accuracy of the algorithm in machine learning with Three parameters.

Keyword:*Thingspeak, LoRa (Long Range), SVM, KNN.*

1. INTRODUCTION

Modern Monitoring and Control is fundamental for gather all the important data, measurements, and information connected with the different modern cycles, engines, machines, and gadgets utilized in modern premises. This focuses on controlled admittance with improved efficiency. Notwithstanding, these remote correspondence procedures are for the most part limited to basic applications due to their sluggish correspondence velocities, distances, and information security. Another arrangement is taken on for thecustomary observing and controls of Industrial applications through the execution of LoRa using high-quality communication and high security. Here LoRa is used totransfer the data that is monitored and controlled. The data canbe seen in the control unit and also the manufacturing unit. Tomake it better clear we have uploaded the data in thing speak for graphical representation and also in a mobile application. We have developed the code to check the accuracy of the algorithm in machine learning with Three parameters.The objective of this project is to control the industry from the controlling side to the manufacturing side using the LoRa (Long Range communication). By taking the data from the current sensor, temperature sensor, voltage sensor, and motor speed. And we have developed the machine learning SVM and KNN algorithm to detect whether the machine has a fault or not using the three parameters such as current, voltage, and motorspeed.

2. LITERATURE SURVEY

Safety is the utmost priority of all industrial sectors as even minimal malfunctions in the mechanisms can lead to unavoidable deteriorating circumstances. Human monitoring system although with good efficiency has its drawbacks as turbulences in the accuracy rate in checking and monitoring mechanisms are inevitable. Total prevention of accidents in industrial workspaces is impossible but preventive measures to near perfection in our motive are achievable. A specified system with diverse technical devices such as sensor- based network integrated monitoring devices lowers the random and human errors produced in the validation process. The modern automation system provides the mechanism with desired sensors to analyze the data and execute the required output basedon the analysis made by the sensors. Human experts' supervision and knowledge is one of the main supports for a good design of the decision making system and its configuration.

2.1 Industrial Automation Monitor and Control using IoT

Ashalatha V and Mr.Devaraju.G. (2022) proposed a System of an embedded is a computer other than the personal computer in order to perform a dedicated purpose. Embedded systems are the admixtures of the components of the intrinsic, chemical, exhilarating undisturbed along with computer. Based on their operational and interpretation stipulations, embedded are classified into four division. Real time embedded that includes both hard and soft embedded system. IoT based System industrial automation monitor andcontrol with Raspberry pi3 and cloud server as it is high secure data transmission, more stable, and faster and can see real time video and analyze the data in the Mat lab analysis inthing speak app.

2.2 IoT Based Industrial Monitoring System Using Arduino

Akshara Viju, Prathamesh Shukla, Aditya Pawar and Prathamesh Sawant.,(2022) proposed an Automated factories and processes are too expensive to be rebuilt for every modification and design change so they have to be highly configurable and flexible. To successfully reconfigure an entire production line requires direct access to most of its control elements such as switches, valves, motors and drives down to a fine level of detail.These kinds of web control system with IoT are characterized by: Energy Saving, Comfort, and Efficiency. Our basic objective is to apply the Internet control system to the Internet of things, such that the customers can use the application from any place around the world with the help of Internet facility.

2.3 Smart Monitoring and Controlling of Appliances using LoRa based IoT System.

Nur-A-Alam , Mominul Ahsan,Md Abdul ,Julfikar Haider and Eduardo M.G.Rodrigues.,(2021) proposed a smart system with modular design proved to be highly effective in controlling and monitoring home.The research work has designed and developed a smart IoT system with ESP32 module and LoRa wireless communication module for long range communication (3 km to 12 km) via transmitting and receiving data at low power consumption in order to overcome the limitation of existing short distance (10 m–100 m) communication technologies appliances from a longer distance with relatively lower power consumption.

2.4 Fault detection Automation in Distributed Control systems using Data driven methods:SVM and KNN

Ahmadi, Seyed Hossein; Khosrowjerdi and Mohammad Javad (2021) proposed a a smart automation system has been designed, developed and tested for effective remote controlling of appliances at home, institute or industry. The system was developed at lowcost with a capability of monitoring and controlling from a distance ranging from 3 km to 12 km through LoRa based wireless communication. Users can monitor the entire condition of the surroundings of the covered area by using the developed android-based software application "LoRa based Smart Institute". Different features such as Smart Office, Smart Industry, Smart Home, etc. with sub-functionalist for each feature were embedded within the app for easy monitoring and controlling of the appliances.

3. PROPOSED METHODOLOGY

The project's transmitter design process is based on data, which is collected through several sorts of sensors like current sensors, voltage sensors, and temperature sensors and using the transformers respectively. These sensors gather data from the sensors continuously and send the data to the PIC microcontroller. The PIC microcontroller sends a signal to the LORA and the corresponding output then it is transmitted to the receiver. At the receiver, data are collected using LORA and it is controlled and monitored using the mobile application. And the dataset is created to compare the efficiency of fault detection in industrial monitoring using the parameters like voltage, current, motor speed, light, and temperature using SVM and KNN algorithms.

3.1 SUPPORT VECTOR MACHINE (SVM ALGORITHM)

The values from the dataset are read and printed. The values of x and y are initialized as [voltage: current:motor speed] and [Label] respectively. Importing SVM files from the library files and printing the lsvc values. Under the while loop, the following is processed when it is true. The dataset values of voltage, current, and motorspeed are read and assigned to field1, field2, and field5 respectively. Then the float values of fields 1, 2, and 5 are declared to variable x_test. The x_test is predicted forfault and the value is stored in dat variable. The condition dat==0 is checked. If the condition is true it prints Normal and prints Abnormal when the condition is false. The graph is plotted for the predicted values. It exits theloop once the graph is plotted and also if the condition isfalse. And the same process is repeated for other values.

3.2 K-NEAREST NEIGHBOURS(*KNN Algorithm)*

The values from the dataset are read and printed. The values of x and y are initialized as [voltage: current: motor speed] and [Label] respectively. Initializing the K Neighbor classifiers from the library files. Assign the values val1, val2,and val3 as Voltage, current, and motor speed respectively. Then the float values of Val 1, 2, and 3are declared to variable x test. Then predicting the values of x test using KNN predict. Print the output values and plot the graphs.

4.DEVELOPED METHODOLOGY

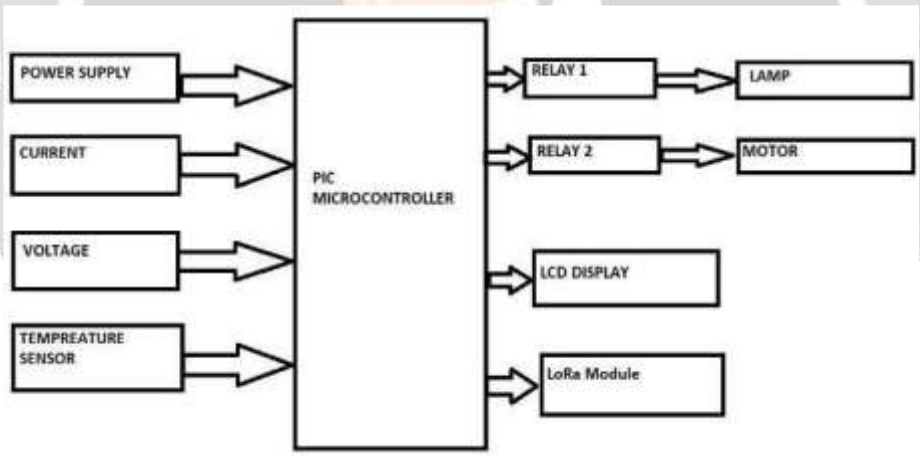

Fig.1 block diagram(transmitter part)

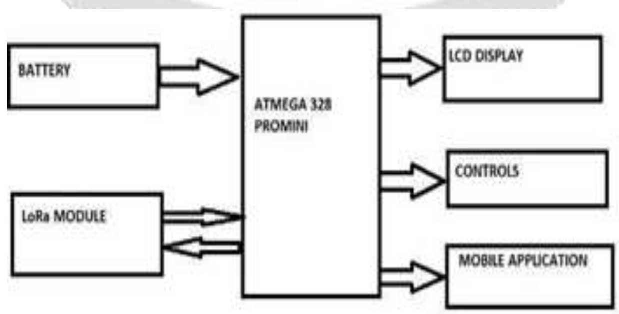

Fig.2 block diagram(receiver part)

The sensors that are connected to the microcontroller sense the data and send it to the controller. The power supply is given to the pic microcontroller and when the power reaches the relay the lamp switch also the motor runs. the sensed datathat is transmitted to the received part through LoRa. Lora is connected with a power supply, and an LCD to display the data that is transmitted. The controls consist of a regulator to control the motor speed, a button which is placed to on and off the light, and other is for the motor. The data are uploaded in the thingspeak for graphical representation. Machine learning is used to find whether the machine is at fault or not. Three parameters are used for detecting the fault of the machine byusing the KNN and SVM algorithms.

5. RESULTS AND DISCUSSIONS

5.1 overall setup

Fig 3.overall setup

The Figure 3 represents the Hardware setup of industrial monitoring using LoRa. It displays the interfacing of various sensors like CT coil, potential transformer and temperature sensor, LCD display and LoRa module with PIC microcontroller.

5.2 K-nearest neighbour(KNN)

```
[101 rows x 3 columns]
0      Fault
1      Fault
2      Fault
3      Fault
4      Fault
       ...
96     Fault
97     Fault
98     Fault
99     Fault
100    Fault
Name: Label, Length: 101, dtype: object
  voltage current motor_speed
0     239       0           0

Warning (from warnings module):
  File "C:\Users\Aksharaa susee\AppData\Roaming\Python\Python310\site-packages\sklearn\base.py", line 493
    warnings.warn(message, FutureWarning)
FutureWarning: The feature names should match those that were passed during fit. Starting version 1.2, an error will be raised.
Feature names unseen at fit time:
- motor_speed
Feature names seen at fit time, yet now missing:
- motor speed

KNN Output: ['Fault']
```

Fig 4.output of KNN classifier.

The figure 4 represents the detection of fault using SVM. The first step involves the reading and printing of dataset from thingspeak application. Then values are predicted and no fault message is displayed because the value of all three fields are correct and normal.

5.3 K-Nearest Neighbour(KNN)

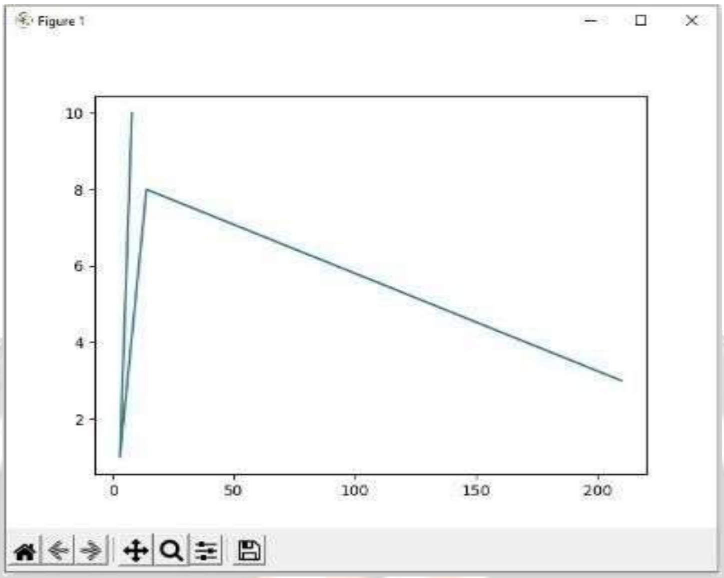

Fig 5.Graphical representation of KNN classifier.

The figure 5 represents the graph of Fault Detection using KNN. The value of current decrease from zero to high peak and value of voltage gradually rises from zero and falls down at certain period of time is displayed in this graph.

5.4 Support vector machine(SVM Algorithm)

Fig 6.output of SVM algorithm.

The figure 5.8 represents the detection of fault using SVM. The first step involves the reading and printing of dataset from thingspeak application. Then values are predicted and fault message is displayed because the value of current and motor speed is zero.

5.5 Support Vector Machine(SVM algorithm)

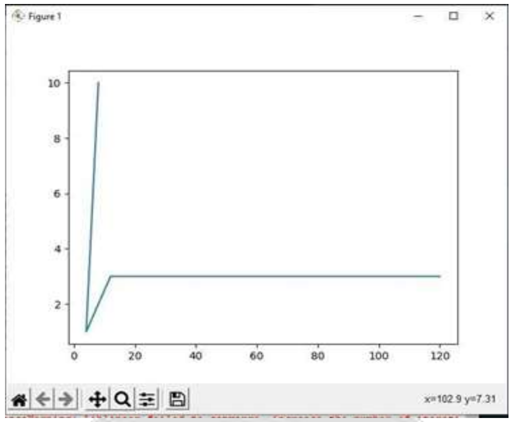

Fig 7.Graphical representation of SVM

The figure 7 represents the graph of Fault Detection using SVM. The value of current decrease fromhigh peak to zero and value of voltage gradually rises from zero and falls down at certain period of time is displayed in this graph.

5.6 *Thingspeak*

The data that are measured using the sensors in the transmitterare sent to the receiver part and the LoRa .and the data from the LoRa are sent to the Thingspeak module for a better understanding by the graphical representation.

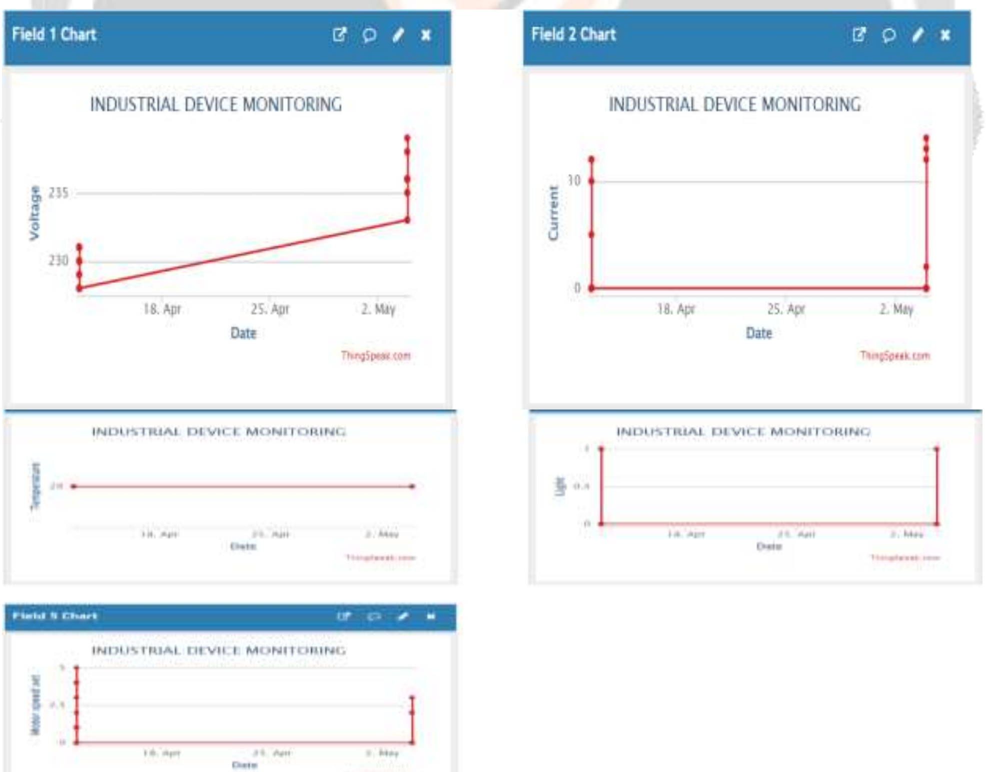

Fig 8.Thingspeak output

5.7 Trained dataset

VOLTAGE	CURRENT	MOTOR SPEED	LABEL
210	0	0	FAULT
211	1	1	NO-FAULT
212	2	2	NO-FAULT
213	3	3	NO-FAULT
214	4	4	NO-FAULT
215	5	5	NO-FAULT

6.CONCLUSION

While the impact of quality assurance and fault detection on modern industrial processes is widely acknowledged, big data and machine learning research for industrial automation is not widely popularized. The Fault detection in the industry can be found using the LoRa module. We performed two main algorithms, k-NN and SVM and achieved classification accuracy exceeding 95% of current and speed sensor faults. The proposed algorithm benefits from minimal human process-supervision requirements due to its generative nature. Future areas of research could include the application of parameter- optimization techniques such as genetic algorithm (GA) and particle-swarm optimization (PSO) to improve the modelling capability of the proposed method. Further improvements to the encoder and classifier of the method will benefit the overall performance of the model. An interesting alternative for future research work would be the investigation into the use of recurrent neural-networks (RNN) to improve temporal predictions of the proposed model, especially through the use of long/short term memory units.

7. REFERENCES

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