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Experimental Study on determining stability of RCR (Rope Climbing Robot) used for bore well rescue using k means anomaly method in Edge Computing

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Abstract

There is an emerging need for rope climbing robot and the major challenge falls in detecting the stability of the robot both in static and in dynamic position. This study can be further improvised to determine the optimal power utilization based on the stability of the robot.. An attempt is made on experimental study for the performance analysis of this rope climbing robot. The abnormalities or the time at which the system starts to get deviate/fail can be determined by k means anomaly method using edge computing. The experiment will help us to design and implement a reactive mechanism to overcome the failure. This reactive mechanism can be a compensator to improve the performance of the robot avoiding the slippage of RCR. This Rope climbing robot is used for enhancing the rescue operation for the children who fall in bore well. Hence it is important to study stability of the bot .

1.Introduction

Edge impulse serving as an online portal enhancing the beginners to play with IoT concept & embedded machine learning. More efficient, rapid and scalable processing data is possible with edge impulse software. The data read from the sensor can be efficiently used via machine learning. The power consumption is less.

2. Procedure:

The 250 gram weighing RAR climbs the rope up and down using to different motor driving force, Apart from the robot driving mechanism, Samsung J2 pro mobile phone tied up together is as shown in fig 2.1 and 2.2. The accelerometer sensor inside the phone is used to read the position of the suction adhesive bot with respect to X,Y, Z axis.

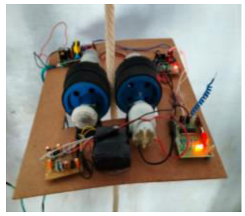

Fig 2.1 The mobile tied up with RCR

Fig 2.2 The rope climbing mechanism carrying the mobile

The edge impulse software connected with IoT is opened in mobile. Edge impulse software with specific login id and password is created, after login the project id will be created. The entire flow of experiments is as shown in the below chart Fig2.3.

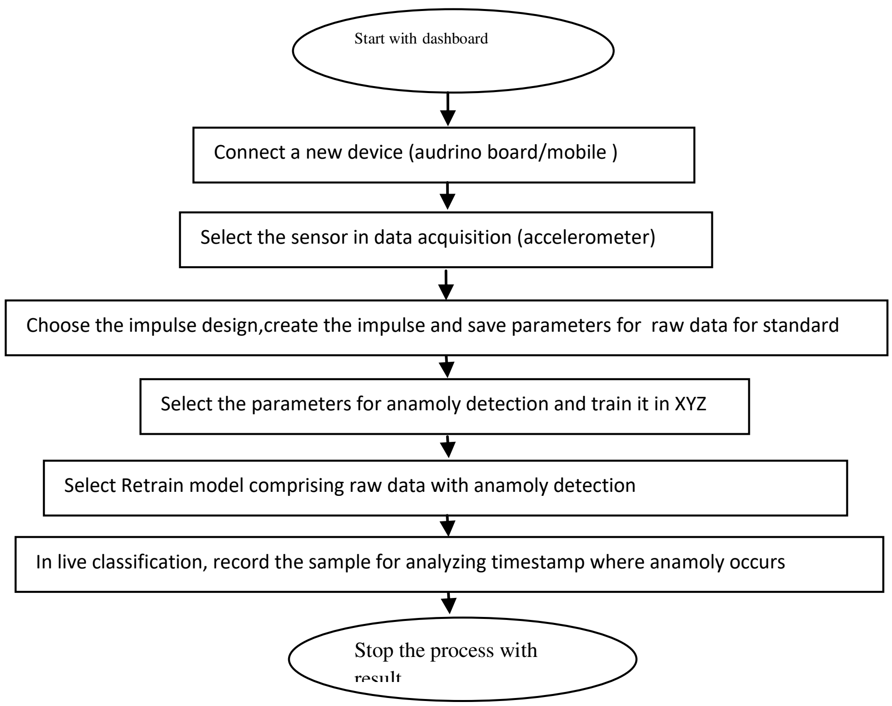

Fig 2.3.Flow chart showing the entire process of experiment

3. Standard Reading: The mobile attached with the RCR is hold (static) horizontally and the reading with the sensor accelerometer is taken which is considered to be the standard reference data upon which the comparison to be made. The dynamic data need to be taken for various trials in order to determine the area of slippage. As shown in fig 3.1 and 3.2 ,the mobile is connected

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to the cloud using Edge impulse platform, this accelerometer output is considered to be the standard which has to be taken as reference as shown in fig 3.3. This reference output /standard output will help to identify the anomaly during the actual trials.

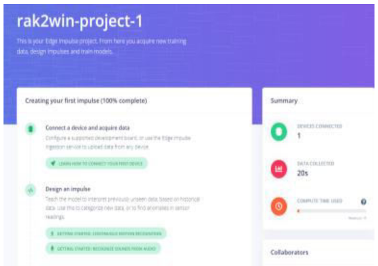


Fig 3.1 - creation of project in the name rak2win

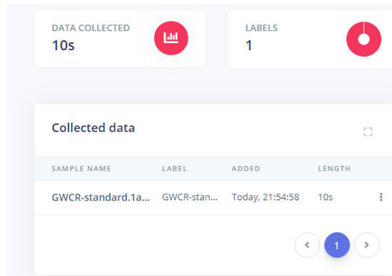


Fig3.2-Data collection for the reference standard signal

Fig3.3-Accelerometer output of standard

4. Creating impulse

With the standard signal parameters trapped now the impulse with k menas anamoly detection to be created ,the fig 4.1 shows the screen shot of the impulse creation.

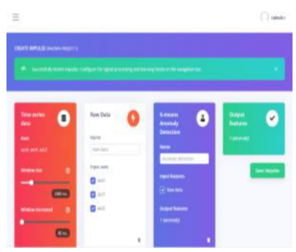


Fig 4.1 Creating an impulse in Edge platform

5. Analyzing the Raw data

The parameters of raw data is trapped from standard signal, the generate feature option is used to view the parameters in x axis, y axis and z axis as shown in fig 5.2and 5.3.

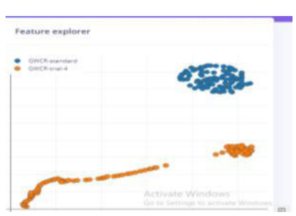


Fig 5.1 – identifying the raw features from standard

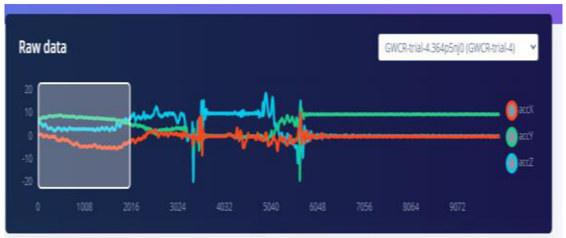
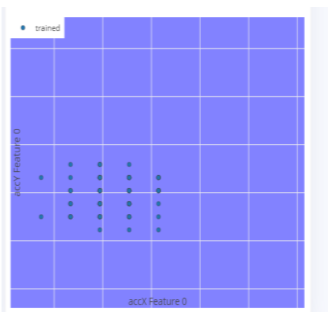


Fig5.2- shows the feature explorer F

6. Anomaly detection setting & Retrain model:

After generating the features from raw data the settings is made for detection of anomaly. As shown in figure 6.2 the retrain is done for the raw data for anomaly detection.



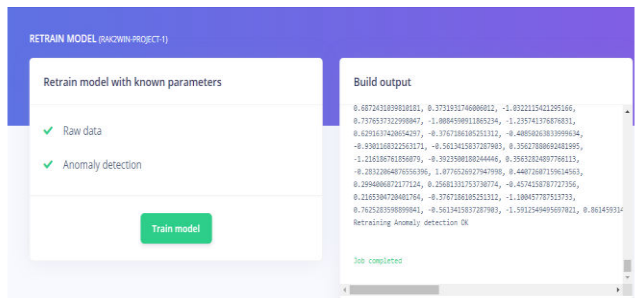


Fig 6.1 – anomaly detection setting Fig 6.2- Retrain of raw data and anomaly detection

7.Live Classification:

Now different trails are made to access the stability of rope climbing robot mechanism. At each trial the raw data of the accelerometer output is trapped and anomaly with respect to standard reference output is explored with respect to X, Y,Z axis. And finally the timestamp for each trial where the anomaly starts occurring is noted .Here four trials are done experimentally with different timestamp.The fig 7.1 shows the live classification panel

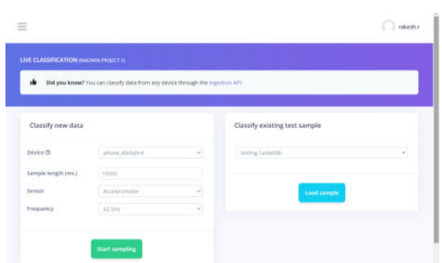


Fig 7.1 – live classification in Edge platform

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8.Testing trial -1 to 4

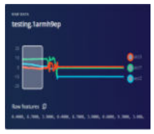

Fig 8.1 – Raw data of trial 1

Fig 8.2- feature explorer for trial 1

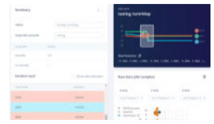

Fig8.3-shows the timestamp for trail 1 Time stamp-1240 sec

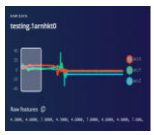

Fig 8.4 – Raw data of trial 2

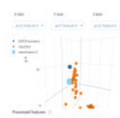

Fig8.5- feature explorer for trial 2

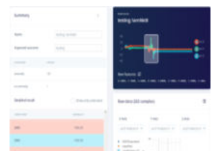

Fig8.6-shows the timestamp for trail 2 Timestamp-2160

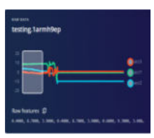

Fig 8.7 – Raw data of trial 3

Fig8.8- feature explorer for trial 2

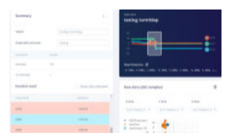

Fig8.9-shows the timestamp for trail 3- Timestamp-3060

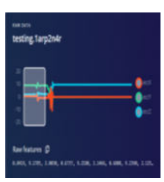

Fig 9.1 – Raw data of trial 4

Fig9.2- feature explorer for trial 4

Fig9.3-shows the timestamp for trail 4 Timestamp-4010

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Conclusion:

A series of 10 trials are made (of which 4 are shown as sample fig 8.1 to9.3) from which timestamp at which anomaly occurs ranges at 1240 seconds, 2160 seconds, 3060 seconds and 4010 seconds. These time stamp were found to be the regular appearance irrespective the number of trials made. It clearly says an attention towards rope climbing mechanism is required for this bot at the above mentioned time stamp interval ,where a designer can think of introducing a standby to balance or improve the stability of the bot much more at this timestamp. This kind of illustration can be arrived by machine learning using internet of things network on wall climbing robot in general.

Reference:

- https://www.edgeimpulse.com
- Rakesh.R,U.Saravakumar,I.KarthicSubramaiyan,"Experimental Study on behavior of SAGWCR (Suction Adhesive Glass wall Climbing Robot) using k means anomaly method in Edge Computing using IIOT n/w" Juni Khyat ISSN: 2278-4632(UGC Care Group I Listed Journal) Vol-10 Issue-7 No. 4 July 2020
- Rakesh et al,U.Saravanakumar ,"The rope climbing robot for rescue enhancement ",Compliance engineering journal,Volume 13,issue 4 ,april2022
- Industrial Internet of Things: Challenges, Opportunities, and Directions, IEEE Transactions on Industrial Informatics (Volume: 14 , Issue: 11 , Nov. 2018), Emiliano Sisinni ; Abusayeed Saifullah ; Song Han ; Ulf Jennehag ,doi-10.1109/TII.2018.2852491
- https://moorinsightsstrategy.com/research-paper-connecting-with-the-industrial-internet-of-things-iiot-2/
- https://www.prnewswire.com/news-releases/2018-study-on-robotics--industrial-internet-of-things-iiot-in-industrial-automation---outlook-to-2023-300761823.html