Automated System for Instruments Calibration

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Abstract:

The system for checking and calibrating measuring instruments. The system is based on calibrating instruments and generates certificates. The system actually provides the required sensitivity, tractability and accuracy of the instrument of the operating platform. This system is use for improve the accuracy of the existing manualsystem. Calibration of measuring instruments has two factors. It checks the accuracy of the instrument and it determines the traceability of the measurement instruments and also generate the report which is provided by the calibration expert, which captured error and calibrate the instrument on the basis of error.The qualities of the system were confirmed by the results obtained from the experiments done.

Index Terms - : Calibration, error detection, machine learning, Data mining, dynamic accuracy.

I. Introduction

The accuracy of all measuring instruments degrades over time. This is typically caused by normal wear and tear. However, changes in accuracy can also be caused by electric or mechanical shock or a hazardous manufacturing environment (e.x,.oils, metal chips etc.). Depending on the type of the instrument and the environment in which it is being use, it may reduce very quickly or over a long period of time. The calibration increase the accuracy of the measuring instruments. Accurate measuring devices improve product quality.Calibration in measurement technology and metrology is the comparison of measurement values delivered by a device under test with those of a calibration standard of known accuracy. The calibration standard isnormally traceable to a national standard held by a National Metrological Institute.

In the existing system of calibration of the instrument is performing manually. In existing system, there is a problem with the accuracy of the instruments. In this context the following activities play an important role: developing the required equipment that ensures the transfer of the unit values from the reference to the operating instruments, and estimating and correcting the measurement errors. These activities are mainly typical of those areas of meteorology where the existing reference base is not sufficiently to provide the complete spectrum of physical quantities. For instance, in the field of dynamic measurements the existing referential elements are very insufficient to cover all areas of measurement of quantities that change within them.

The system required different methods like average value/mean value, Standard uncertainty, and the standard deviation for finding false positive, false negative, true positive, true negative errors for finding calibration accuracy of a particular object.

The proposed system aims to be useful in calibration lab, Industrial companies, and mechanical lab. Based on Accuracy of measuring instrument during calibration and generate the report which is provided by the calibration expert, which captured error and calibrate the instrument on the basis of error using data and show proof of the calibration in the form of certificate.

II. RELATED WORK

DimitarDichev, HristoforKoev, DimitarDiakov, NikolayPanchev,RosicaMiteva, HristiyanaNikolovadescribe the "Automated System for Calibrating Instruments Measuring Parameters of Moving Objects" The system described the views a model of a system for checking and calibrating measuring instruments operating on moving objects, in particular on ships. The system is a stand simulator based on a six-degree-of-freedom Stewart platform. In this system the mathematical model, based on the inverse kinematics problem of parallel mechanisms, is universal enough to be used in the development of other systems for calibrating devices operating on various moving objects such as automobiles, aircrafts, etc. The referential qualities of the system are ensured by a specifically developed output device which is calibrated by means of references for length. The qualities of the system are confirmed by the results obtained from the experiments done [1].

D. Dichev, H. Koev, T. Bakalova, and P. Louda,describe the An Algorithm for Improving the Accuracy of Systems Measuring Parameters of Moving Objects. In this paper, considers an algorithm for increasing the accuracy of measuring system operating on moving objects. The algorithm is based on the Kalman filter. It goal to provide a high measurement accuracy for the whole range of change of the measured quantity and the interference effects, as well as to eliminate the influence of a number of interference sources, each of which is of secondary importance but their total impact can cause a considerable distortion of the measuring signal.This problem could be solved by using adaptive algorithm integrated in the metrological chain of measuring systems .A Characteristic feature of instrument measuring parameter of moving objects is their operation in dynamic conditions.But the Variation of their values can be caused by process variation [4].

D. Dichev, H. Koev, and P. Louda,describe the "A Measuring System with an Additional Channel for Eliminating the Dynamic Error" In this paper, measuring systemensures high accuracy of measurement of the ship's heel and trims both in static and dynamic operating mode. The metrological circuit of the system is based on a gyro-free design of the vertical unlike most systems built on this principle. The simplified design of the system's mechanical module guarantees a minimal instrumental error of the measuring system, which appears of great importance for ensuring the accuracy of measurement, especially in static mode. Its principle of operation is based on eliminating the dynamic error due to the deviation of the vertical in the inertial space in real time. The mechano electro-mechanical systems (MEMS) are used. When a Kalman filter is connected to the system, the measurement accuracy in dynamic mode is increased because the filter reduces not only the secondary fluctuations caused by external actions, defined by, but also the influence of the main interference presented in this article. Also this system having some disadvantages design includes very much complex procedures, time consuming and components are costly [13].

III.IMPLEMENTATION

In this system, instrument calibration of the mechanical module to improve the current calibration system. Calibration in measurement technology and determinationis the comparison of measurement values delivered by a device under test with those of a calibration standard of known accuracy. The main purpose of this system is to checks the accuracy of the instrument and determines the traceability of the measurement. And generate the report which is provided by the calibration expert, which shows the error in measurements with the measuring device before and after the calibration.In the database,variousinstruments measuring standard values are stored. By using this system we can retrieve/trace the required standard values related to the instruments which is already stored in database.The calibrationstandard is normally traceable to a national standard held by aNMI(National Metrological Institute).

The System Architecture diagram shown in below offers more details information about the system.

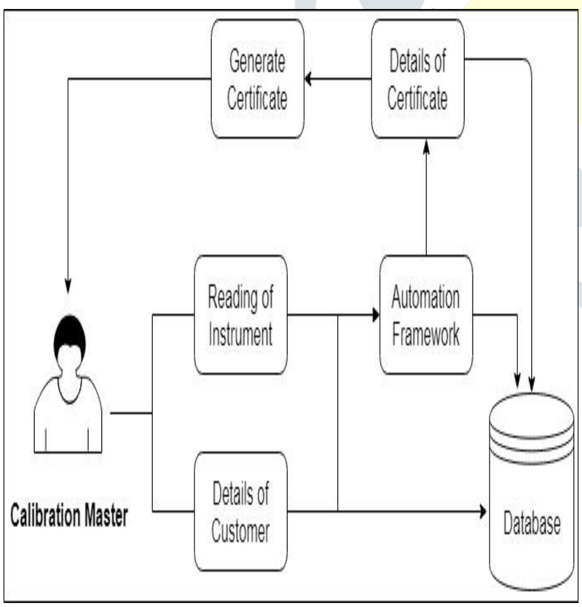

Fig. System Architecture.

The qualities of the system are confirmed by the results obtained from the experiments done and result/certificate calibration laboratory often provides a certificate with the calibration of an instrument. The calibration certificate provides important information to give the instrument's owner confidence that the instrument was calibrated correctly and to help show proof of the calibration. A calibration certificate might include a statement of traceability or a list of the calibration standards used for the calibration, any data resulting from the calibration, the calibration date, and possibly pass or fail statements for each measurement instrument.To explain how calibration is performed we can use an external micrometeras ansample. Here, accuracy of the scale is the main parameter for calibration. In addition, these instruments are also calibrated for zero error in the fully closed position and flatness and parallelism of the measuring surfaces. For the calibration of the scale, a calibrated slip gauge is used. A calibrated optical flat is used to check the flatness and parallelism.

Advantages of Proposed System:

- High Accuracy.
- Guarantees a minimal error of measuring instruments.

We are using following Methods:

(i) Mean Value:

$$\bar{X} = \frac{X_1 + X_2 + X_3 \ldots X_N}{N}$$

Where
$\bar{X}$ = the mean
X_1 = the first value
X_2 = the second value
X_3 = the third value
X_N = the last value
N = the number of valuse

Mean value can be calculated by total of N numbers in data set whose values are given by a group of X-values i.e.X_1, X_2, X_3, ….,Xn. then the mean is represented by $\bar{X}$ (measured values)can be found using above formula.

(ii) Standard Deviation:

$$s^2 = \frac{\sum (x-\bar{x})^2}{n-1}$$

The standard deviation (σ) is simply the square root of the variance. Where $\sum$ is sum, x is a term in data set, $\bar{x}$ is a sample mean value and n is a sample size. The standard deviation is a statistic that measures the dissolution of a dataset relative to its mean and is calculated as the square root of the variance. It is calculated as the square root of variance by determining the variation between each data relative to the mean.

(iii)Variance:

$$s^2 = \frac{\sum (x-\bar{x})^2}{n-1}$$

The variance is a measure of how far each value in the data set is from the mean value. Here is how it is defined:

1. Subtract the mean from each value in the data. This gives you a result of the distance of each value from the mean.

2. Square each of these distances and add all of the squares together.

3. Divide the addition of the squares by the number of values in the data set.

(iv) Standard Uncertainty:

$$s_{\bar{x}} = \frac{SD}{\sqrt{N}}$$

To calculate Standard uncertainty of your measurements, first you'll need to find the standard deviation (σ) and the square root of number of measurement values (N).

For describe in more details we take an example of micrometre.

- Take five measured value of micrometre.
- Slip gauge is the master of micrometre.
- First calculate the mean value of measured value.
- Calculate variance of measured value.
  i. Subtract the mean from each measured value of micrometre. This gives a result of the distance of each value from the mean.
  ii. Square each of these distances and add all of the squares together.
  iii. Divide the addition of the squares by the number of values in the data set.
- Then take a square root of variance which is standard deviation.
- Calculate the standard uncertainty which is nothing but the ratio of standard deviation and square root of no. of measured values.

As per above steps system generate the result if any error is occurred then it give in the certificate.

CONCLUSION

In propose work an instruments measuring system, ensures high accuracy of measurement of the instruments. The simplified design of the system's mechanical module guarantees a minimal instrumental error of the measuring system, which appears of great importance for ensuring the accuracy of measurement. Accurate measuring devices improve product quality. The system is used for the more accuracy of the instruments.The qualities of the system were confirmed by the results obtained from the experiments done. Result provides important information to give the instrument's owner confidence that the device was calibrate correctly and to help show proof of the calibration.

ACKNOWLEDEGMENT

Authors want to acknowledge Principal,(HOD)Head of department and guide of their project for all the support and help rendered. To express profound feeling of appreciation to their regarded guardians for giving the motivation required to the finishing of paper. Specially, we are thankful to Jaihind College of Engineering for providing the resources. We are also thankful to Prof. A .A Khatri, project coordinator, and Guide, for continuous support.

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