ARC SERIES RAIN GAUGE CALIBRATOR: A Review

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Abstract: The observation and measurement of rain water is essential and requires accuracy. For this measurement tipping bucket rain gauge is extensively used and to improve accuracy of this rain gauge calibration is required. In traditional methods the calibration consist of varying frequency of flow of water by using VFD and measuring the output of gauge. This may include errors as well as human efforts which can be minimized using ARC series rain gauge calibrator. This calibration system comprises of volumetric method. The rate of water flow rain gauge is controlled by the pump; rain gauge triggers the electric signal of each tipping bucket which resemble actual rain fall rate. This calibration system involves less of human interface which improves accuracy standards, reliable calibration value and efficiency and hence reduces human error.

Index Terms – Rain Gauge, Data Logger, Tipping Bucket, Rain Gauge Calibration.

I. INTRODUCTION

Rain Gauge:

Udometer is an associate instrument utilized by meteorologists and hydrologists to assemble and live the quantity of downfall.

Types of rain gauge:
1. Ordinary rain gauge
2. Self-recording rain gauge
3. Tipping bucket rain gauge

Ordinary rain gauge: this sort of udometer is the most typical form of rain gauge utilized by the meteoric department. The rain falls on aggregation space so a receiving bottle features a capability of 100mm and through serious downfall, the quantity of rain is usually exceeded, therefore the reading ought to be measured three to four times in a very day. Water contained during this receiving bottle is measured by a graduated activity glass with accuracy up to 0.1mm. For uniformity, the downfall is measured daily at 8:30 Am IST and is recorded as the downfall of the day.

Self-recording rain gauge: advisement bucket-type udometer is the most typical self-recording rain gauge. It consists of a receiver bucket supported by a spring or lever balance or another advisement mechanism. The movement of bucket thanks to its hyperbolic weight is transmitted to a pen that traces record or some marking on a clock-driven chart**.**

Tipping bucket rain gauge: combine of buckets square measure pivoted beneath this funnel in such a fashion that once one bucket receives 0.25mm of precipitation (rainfall), it tips discharging its downfall into the instrumentation, conveyance the opposite bucket beneath the funnel. Tipping of bucket completes an electrical circuit inflicting the movement of the pen to mark on a clock-driven receiving drum that carries a recorded sheet. These electrical pulses generated square measure recorded at the room distant from the udometer station.

The udometer calibrator will simulate varied downfall settings. The activity is finished by performing arts the info measure comparison between the calibrator and therefore the udometer readouts. The machine downfall activity system relies on fashionable technology, software system application technology, network technology, natural philosophy info technology, and national relevant activity standards. It realizes the automated activity of assorted styles of rain gauges and therefore the centralized management of information. The activity method yield while not labor concerned, that directly improve the activity potency, eliminate human error, and generate correct and reliable activity worth.

II. RELATED WORK

Table 1 details the brief comparison of the rain gauge calibration techniques that are employed automatic rain gauge calibration systems. The complexity of the design system is judged based on number of stages involved.

Table 1: Comparison				
Author	Techniques	Sensors	Method	Formula
Paul Muñoz, Rolando Célleri, and Jan Feyen [3]	Effect of the Resolution of Tipping-Bucket Rain Gauge and Calculation Method on Rainfall Intensities in an Andean Mountain Gradient	DRTB rain gauge laser-optical disdrometer	Rainfall Intensity- Tip Counting and Cubic Spline	1) Percent Absolute Bias= $(\frac{1}{n}\sum_{i=1}^{n} x_i\text{-}y_i\|)$
J Y Lee, J A Hevesi, A L Flint [2]	A New Method for Automated Dynamic Calibration of Tipping-Bucket Rain Gauges	Programmable Pump, Data Logger, Digital Balance Computer	Pump Calibration, Rain Gauge Calibration	Rain gauge resolution(r)= $4\,v/\pi\,d^2$ v- volume of bucket d- rain gauge diameter t=mx+b t- bucket tip time m-slope x-reciprocal of true rate b-y axis intercepts
M A A Santana, P L O Guimaraes, L G Lanza [1]	Development of procedures for calibration of meteorological sensors.	TBRG, Data Logger	Volumetric or Gravimetric	1. Rainfall Intensity=$Qt^{-1}.3600$
Octavian Postolache, Miguel Dias Pereira, Pedro Girão, [5]	Smart wireless tipping bucket rain gauge-measurement and automatic dynamic calibration	TBR, RF receiver-transmitter, Data logger, Temperature sensor	Multi-channel data acquisition and calibration.	1) Counting the pulses, NRW for 1h time period the total amount of rainwater can be calculated using the following relation: $q_{RW(1h)} = N_{RW}.r$ which express the rainfall intensity level expressed in mm/h.
Marcio A. A. Santana, Patricia L. O. Guimarace, Luca G. Lanza [6]	Metrological analysis of a gravimetric calibration system for tipping-bucket rain gauges	Digital caliper, Weighing, Data logger, Temperature sensor	Static and dynamic calibration	1) Equation 1 simplifies the rainfall quantity Q obtained by a TBRG as the ratio of the water volume V on the catchment area A : Q=V/A
Molini A., Cassini G., Lanza L.G. and L. Stagi, [7]	Dealing with uncertainty in rainfall gauges calibration: the QM-RIM metrological validation	Module for Qualification of Rainfall Intensity Measurements (QM-RIM)	The QM-RIM Meteorological validation	1) The law controlling the generation of synthetic flow rates in the QM-RIM is: Q = Ω· ξ √2gH)

EXPLANATION: the above mentioned table includes paper which through light upon various methods to calibrate a rain gauge. Authors have used different sensors and methodologies to calibrate a rain gauge, depending above the feasibility and requirements. By studying these papers in detail we can propose a new methodology.

III. METHODOLOGY

This paper deals with the aim of analysis within which technology promotes automation in the pluviometer standardization system. It's a tough task to keep up the accuracy & preciseness in pluviometer standardization which may cause improper prognostication study of measuring of downfall in numerous places. Hence, to develop Associate in the Nursing device as common place typical regular customary standardization Device that has absolute best accuracy & repeatability is critical therefore on comparing different calibrators with reference to this standard device.

The aim of the paper is to calibrate the tipping bucket pluviometer that primarily concentrating on following applications such as:-
I. To perform the info measuring comparison between the calibrator and pluviometer readouts.
II. To precede the standardization method while not labor concerned that parts human error and generates reliable a correct worth.

All the rain gauges square measures required to be marked. Standardization may be a method of scrutiny for the host instrument with the commonplace instrument. In earlier days manual calibrators wherever wont to calibrate rain gauges, the

intensity of downfall is controlled victimization VFD (Variable Frequency Drive). To calibrate the pluviometer the host pluviometer is placed in a testing chamber. As we alter the intensity of input the out changes step by step. And this transformation is recorded manually. From the on top of the literature survey, it will be summarized that's a chance of bound drawbacks.

1. Manual system
2. The manifestation of manual error.

The pluviometer calibrator will simulate varied downfall settings. The standardization is finished by acting the info measuring comparison between the calibrator and also the pluviometer readouts. Automobile downfall standardization system is predicated on trendy technology, computer code application technology, network technology, physical science info technology, and national relevant standardization standards. It realizes the automatic standardization of varied styles of rain gauges and centralized management of information. The standardization method takes while not labor concerned, that directly improve the standardization potency, eliminate human error, and generate correct and reliable standardization worth. The automobile downfall standardization system includes a bunching machine and automatic standardization computer code. First off water injected into the quality ball ought to reach the mark water volume, then the water discharge management unit can inject water into pluviometer at a selected rate, thereby stimulating totally different rain intensity of pluviometers and also the mark knowledge square measure recorded to see the deviation of the rain gauge.
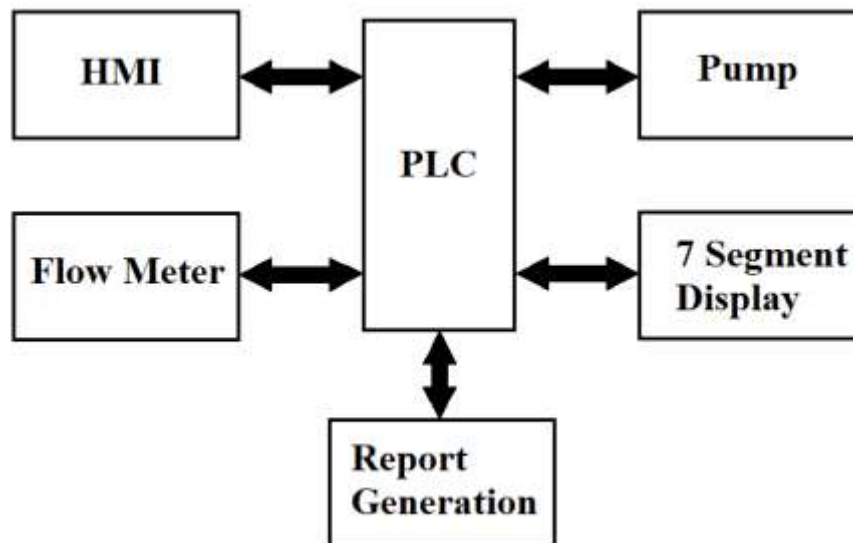

Figure 1: Block diagram of a planned system

The automobile downfall standardization system includes a punching machine and automatic standardization computer code. First off water injected into the quality ball ought to reach the mark water volume, then the water discharge management unit can inject water into pluviometer at a selected rate, thereby stimulating totally different rain intensity of pluviometers and also the mark knowledge square measure recorded to see the deviation of the rain gauge.

Calibration may be a method of scrutiny for the host instrument with a commonplace instrument. In earlier days manual calibrators wherever wont to calibrate rain gauges, the intensity of downfall is controlled victimization VFD (Variable Frequency Drive). To calibrate the pluviometer the host pluviometer is placed in a testing chamber. As we alter the intensity of input the out changes step by step. And this transformation is recorded manually.

IV. CONCLUSIONS

ARC series auto rainfall calibration system is based on modern computer technology, software application technology, network technology, electronic information technology and national relevant standards. It realizes automatic calibration of various types of rain gauges and centralized management of data. The calibration process proceeds without labor involved, which greatly improves the calibration efficiency, eliminates human error, and generates accurate and reliable calibration value.

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