International Journal of Scientific Research in Science and Technology
Print ISSN: 2395-6011 | Online ISSN: 2395-602X (www.ijsrst.com)
doi : https://doi.org/10.32628/IJSRST

Prediction of Cavitation in Centrifugal Pump Using IIOT

Madhuri Dhage[1], Shraddha Jadhav[1], Sneha Garad[1], Girish Mhaske[1], Prof. Ranjit Kapurkar[2]

[1]Department of Mechanical Engineering, D Y Patil School of Engineering and Technology, Lohegaon, Pune, Maharashtra, India

[2]Professor, Department of Mechanical Engineering, D Y Patil School of Engineering and Technology, Lohegaon, Pune, Maharashtra, India

Article Info

Volume 9, Issue 3

Page Number : 219-222

Publication Issue

May-June-2022

Article History

Accepted : 10 May 2022

Published : 23 May 2022

ABSTRACT

Cavitation normally generates random, high frequency broadband energy, which is Sometimes superimposed with the blade pass frequency harmonics. Gases under pressure Can dissolve in liquid. When the pressure is reduced, they bubble out of the liquid. In a Similar way, when liquid is sucked into a pump, the liquid's pressure drops. Under Conditions when the reduced pressure approaches the vapor pressure of the liquid (even at Low temperatures), it causes the liquid to vaporize. As these vapor bubbles travel further Into the impeller, the pressure rises again causing the bubbles to collapse or implode. This implosion has the potential to disturb the pump performance and cause damage to the Pump's internal components. This phenomenon is called cavitation. Each implosion of a bubble generates a kind of impact, which tends to generate high-frequency random vibrations. Cavitation can be quite destructive to internal pump components if left uncorrected. It is often responsible for the erosion of impeller vanes. Measurements to detect cavitation are usually not taken on bearing housings, but rather on the suction piping or pump casing. simulate cavitation/non- cavitation in centrifugal pump.

Keywords: Arduino, Accelerometer, Calibration of Accelerometer, Methodology, Conditions

I. INTRODUCTION

Centrifugal pump is far the most commonly used pump in industry for fluid delivery. pump performance reflects in the characteristics curves in terms of discharge flow rate and pump head. The term cavitation implies a dynamic process of formation of bubbles inside the liquid, their growth and subsequent collapse as the liquid flows through the pump.Cavitation is caused for a number of reasons such as varying operating conditions, inadequate installation and harsh environments. The formation occurs on the suction side of the blade at low flow rate and on the pressure side at high flow rate. Centrifugal pumps are critical process equipment and, failure free operation is of vital importance to production. Moreover, the centrifugal pump is one of the most common rotating machines, and it is widely applied by various industries for different processes and purposes starting from pumping and shifting liquids like water and even heavy and sensitive ones like oil and chemicals. Therefore, the detection of faults and monitoring the health condition of centrifugal pumps is considered to be important in oil and gas industries.

II. ARDUINO

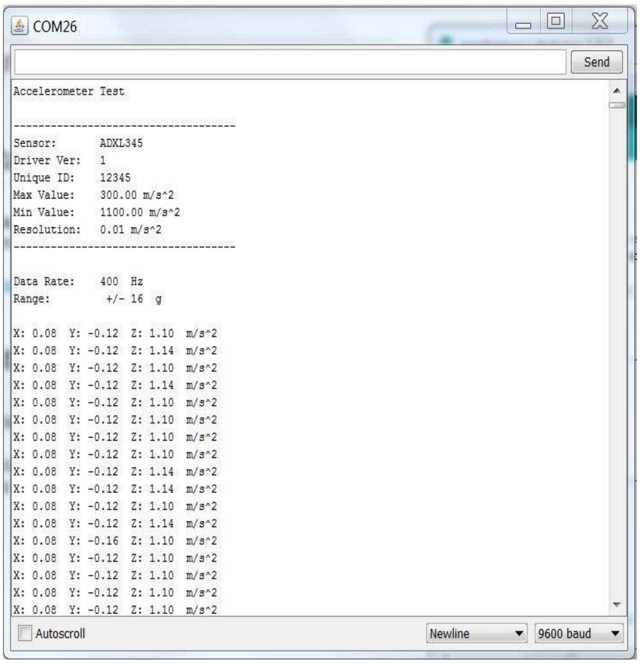
The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board -- you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

III. ACCELEROMETER

ADXL345 measures static acceleration due to gravity as well as dynamic acceleration resulting from motion or shock. The sensors come in a 14-lead LGA package having just 3mm x 5 mm x 1 mm dimensions. This sensor can be used in mobile device applications like mobile handsets, smartphones, gaming devices, pointing devices, personal navigation devices, hard drive protection, medical and industrial instrumentation.

IV. CALIBRATION OF ACCELEROMETER

The ADXL chips are calibrated at the factory to a level of precision sufficient for most purposes. For critical applications where a higher degree of accuracy is required, you may wish to re-calibrate the sensor yourself. Calibration does not change the sensor outputs. But it tells you what the sensor output is for a known stable reference force in both directions on each axis. Knowing that, you can calculate the corrected output from a sensor reading. For this calibration we require a program which has Adafruit library.



V. METHODOLOGY

Industrial Internet of Things abbreviated as IIoT is simply the connection of devices to the internet. These devices may have a networking component embedded in them or require a separate gateway to provide the networking component. The goal of IIOT as part of the setup is to absorb the sensor data from the amplifiers to the cloud.

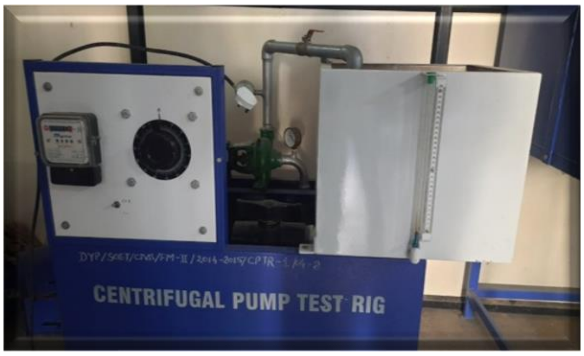
Mechanical components design

This has to do with specification of parameters of the mechanical components of the test rig. The selection of motors and pump are the most important factors for the performance of the test rig as the motor provides energy needed by the pump to move the working fluid while the pump demonstrates the capability of moving the fluid Sizing of the motors and centrifugal pump The motor specifications are as follow:

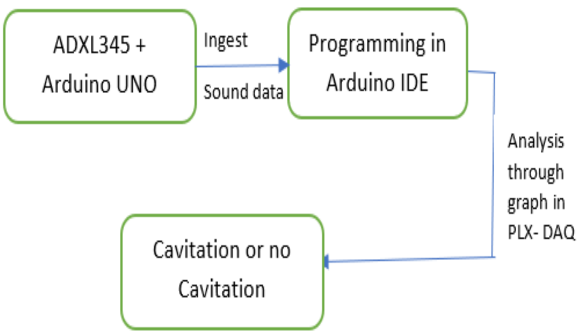
i. Centrifugal pump 25*25mm size ,base mounted max total head 11,discharge 1.5 lps ,at 2900rpm.
ii. Motor-1HP, dc.motor directly coupled to pump.
iii. Measuring tank 400*400*450mm heightfitted with gauge tube and drain valve.
iv. Sump tank 600*900*600mmheight.
v. Tachometer to measure speed of the pump.
vi. Pressure gauge to measure discharge pressure.
vii. Vacuum gauge to measure suction vacuum.

Experimental Setup Design

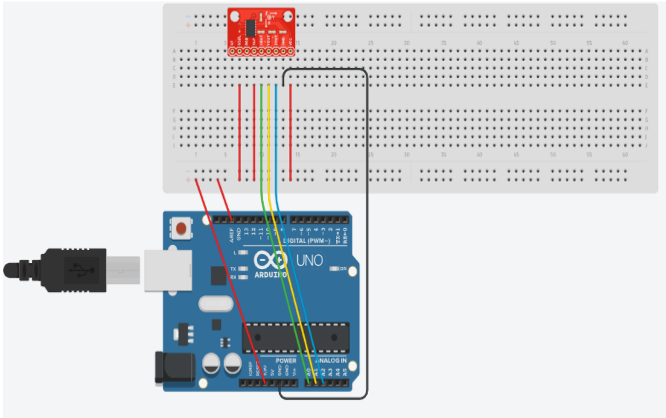
The experimental setup consists of centrifugal pump test rig and the Arduinoaccelerometer configuration.



IIOT System Architecture



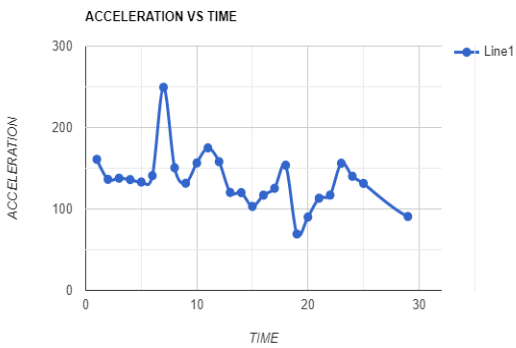
Arduino UNO Circuit



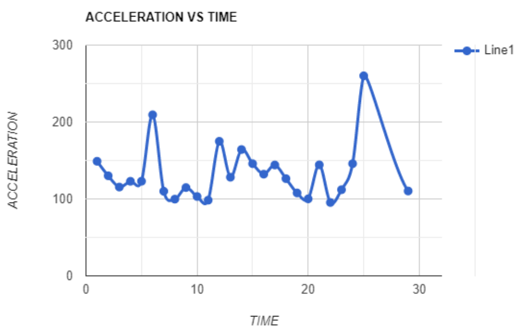
VI. CONDITIONS

i. Discharge valve close (Almost 45 Degree) suction head: 25.1cm
ii. Discharge valve close (Almost 90 degree) suction head: 25.1cm
iii. discharge valve close (Almost 90 degree) suction head: 12.5cm

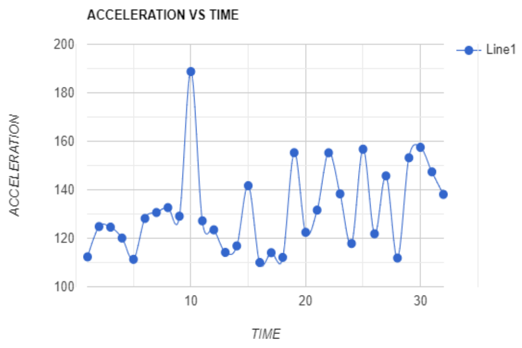
VII.RESULT



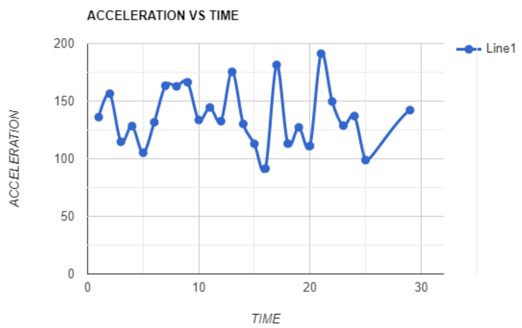
Graph for normal working of pump

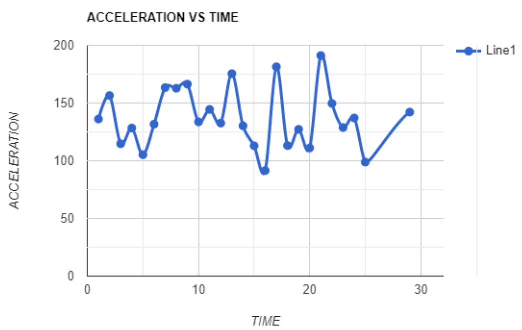


Graph for discharge valve close (Almost 45 degree) suction head: 25.1cm



Graph for discharge valve close (Almost 90 degree) suction head: 25.1cm





Graph for discharge valve close (Almost 90 degree) suction head: 12.5cm

VIII. CONCLUSION

From the experimentation, cavitation is a function of flow rate of the fluid which may be high at the side of suction of the pump. Cavitation is controlled by putting obstacle to optimized the flow structure and weaken the vortex intensity close to the volute area of the pump.

IX. REFERENCES

[1]. Thobiani A, Fengshou GF, Andrew B, “The monitoring of cavitation in centrifugal pumps based on the analysis of vibroacoustic measurements”. 7th International Conference on Condition Monitoring and Machinery Failure Prevention Technologies, Stratford-upon-Avon, UK. 22-24 June 2010. Google Scholar

[2]. Bill Earl, Liz Clark, KattniRembor, Danny Nosonowitz,2019

[3]. B.P. Kamiel, Vibration-Based Multi-Fault Diagnosis for Centrifugal Pumps, 2015.

[4]. Y. Luo, H. Sun, S.Q. Yuan, J.P. Yuan, Research on statistical characteristics ofvibration in centrifugal pump, Adv. Mech. Eng. 7 (11) (2015).

[5]. Zhao W, Zhao G An active method to control cavitation in a centrifugal pumps by obstaclesAdvances in Mechanical Engineering, 9 (11) (2017), pp. 1-15

[6]. Khurmi, R. S. and Gupta, J. K., 2005. A Textbook of Machine Design. New Delhi: EurasiaPublishing House Accessed 5 December 2018].

[7]. E. Shashi Menon, P.E., 2005. Piping Calculations Manual. Available at www.knovel.com.Copyright © 2005 McGraw-Hill Accessed 29 January 2020]

Cite this article as :

Madhuri Dhage, Shraddha Jadhav, Sneha Garad, Girish Mhaske, Prof. Ranjit Kapurkar, "Prediction of Cavitation in Centrifugal Pump Using IIOT", International Journal of Scientific Research in Science and Technology (IJSRST), Online ISSN : 2395-602X, Print ISSN : 2395-6011, Volume 9 Issue 3, pp. 219-222, May-June 2022.
Journal URL : https://ijsrst.com/IJSRST229344