Project Proposal

On

Development of IoT powered Low cost Vibration Spectrum Analyser

for
IoT based Smart Manufacturing

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Problem Statement:

Modern technological processes require the continuous monitoring of many parameters of technological equipment. The most important parameters are mechanical parameters such as periodic mechanical vibrations.Vibration monitoring systems make possible to solve a lot of the problems coupled with vibrations that appear during the technological equipment operations. Thus, DEVELOPMENT OF IoT BASED VIBRATION MONITORING AND SPECTRUM ANALYSIS SYSTEMS FOR TECHNICAL OBJECTS is an important task.

Objectives

- To design a low cost alternative to vibration monitor and spectrum analyser using the Raspberry Pi microcomputer and 3-axis digital MEMS ADXL345 accelerometer.

- To study if inexpensive vibration monitoring systems could be suitable for condition monitoring

- To highlight the impact of different components of the signal chain to the measured vibration signal itself and familiarize the reader with the signal chain found in vibration monitoring.

- To analyze vibration parameters in order to predict and prevent possible accidents, thus reducing the costs associated with the failure of the cutting tools, expensive parts and assemblies of the CNC machine

REMOTE

SCALABLE
SYSTEM

Literature Review

- Mechanical Vibration is a Waving motion of bodies from its rest point, where it occurs due to the presence of restraint.There are two main ways to detect vibration displacement in recent years: contact measurement and non-contact measurement

Journals & Paper referred:

1. J. Liu, P. Wang and X. Tian, "Vibration displacement measurement based on three axes accelerometer," *2017 Chinese Automation Congress (CAC)*, Jinan, 2017, pp. 2374-2378. doi: 10.1109/CAC.2017.8243173

2. Jicheng Liu, Qinghua Xu, Jianxin Zha, "Method for measuring vibration displacement by acceleration sensor[J]", *Modern radar*, vol. 29, no. 5, pp. 69-71, 2007

Market Review :

Precise Vibration meter VB-8201 - Precise
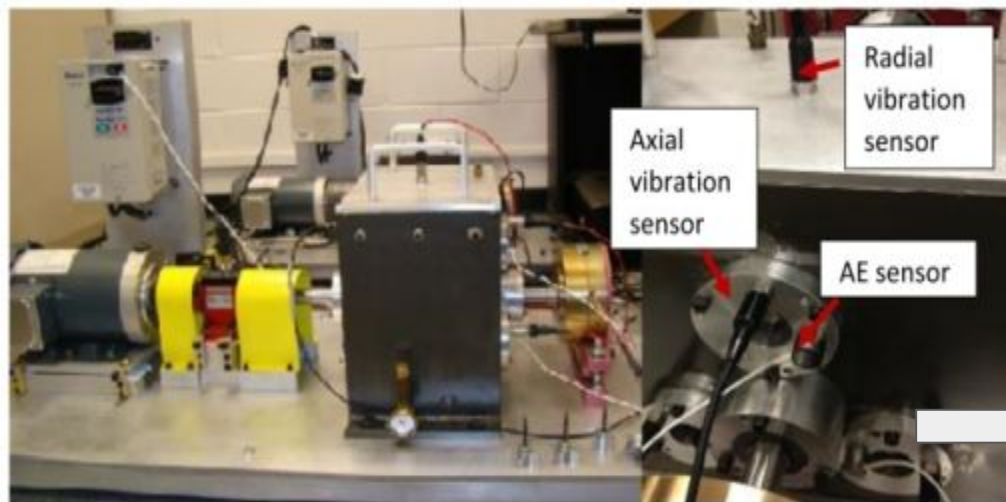₹ 8,038.00 from IndustryBuying
Precise **Vibration** Meter, Testing And Measuring Instruments, Non Electrical Properties Testing, **Vibration** Meter From Industry ...

iAdept Reliability - Vibrations Meter - Vibration Analyser - Vibration Data Collector
₹ 99,500.00 from TradeXL
Vibrations Meter - **Vibration** Analyser - **Vibration** Data Collector

Radial vibration sensor

Axial vibration sensor

AE sensor

Rough Flowchart to explain the details

1xRPM - BALANCE

2xRPM - ALIGNMENT

3-5xRPM - LOOSENESS

ANTI-FRICTION BEARINGS & GEARMESH

5-25xRPM

25-65xRPM

20000

5000   10000   15000

Frequency Hz

Signal Processing Flow

Transducer

Waveform

Amplitude

Time

FFT

Spectrum

Amplitude

Frequency

Data Collector/Analyzer
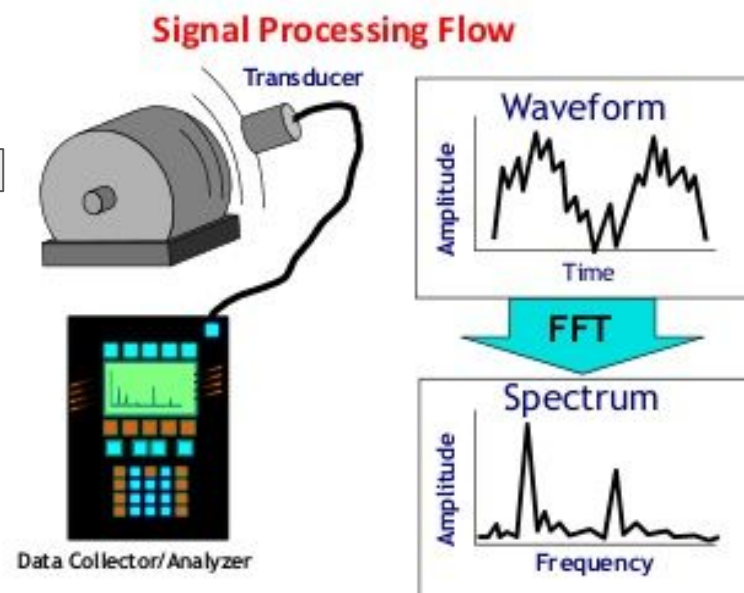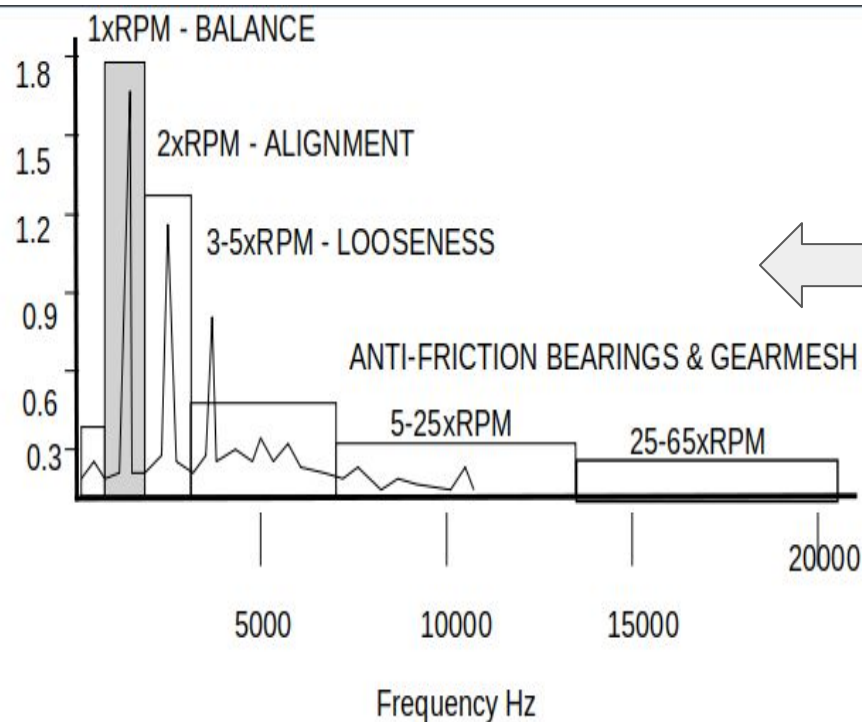
On a Large Scale . . .
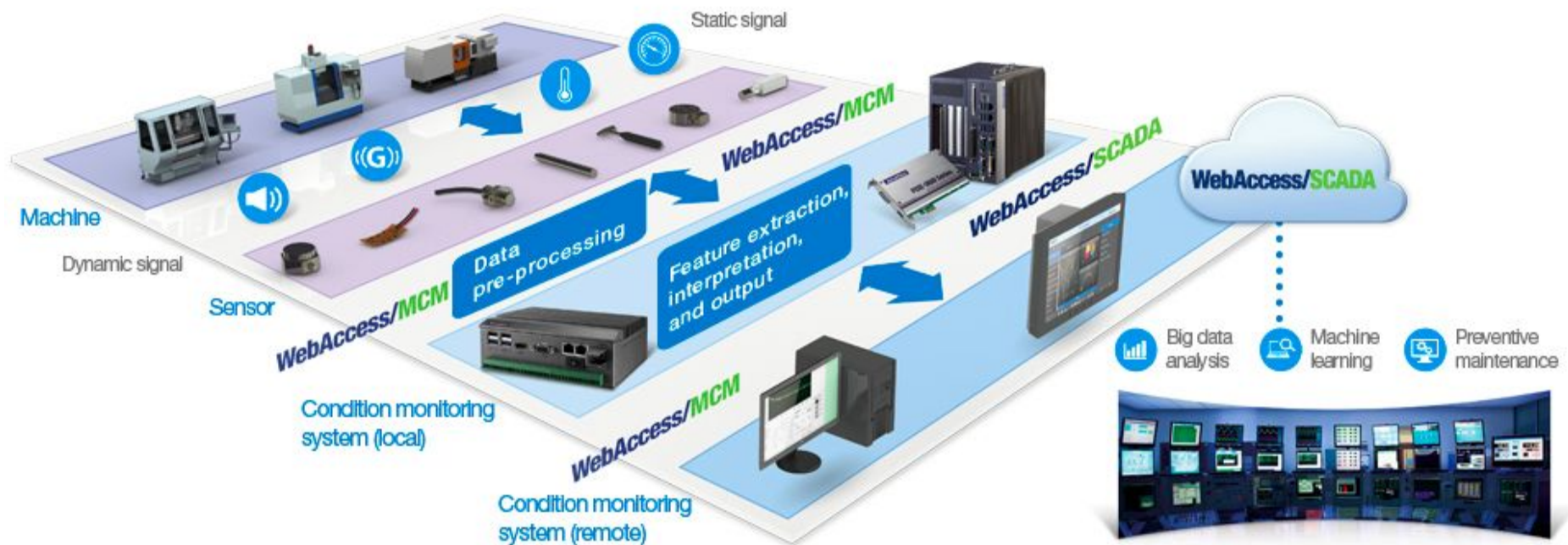
Implementation & BoM

Category and Item	Item Notes	Budget	Actual	Difference
1 ☐ **Items**	Links / Source	**₨4,695.00**	**₨3,574.00**	**₨1,121.00**
2 ☐ **Hardware**	Biggest expense	**₨4,053.00**	**₨3,228.00**	**₨825.00**
3 Raspberry Pi 3 Model B	https://www.amazon.in/Raspberry-Pi-3B-plus-Motherboard/dp/B07BDR5PDW	₨3,133.00	₨2,300.00	₨833.00
4 Monitor		₨0.00		₨0.00
5 16 GB SD Card	https://www.amazon.in/SanDisk-Ultra-microSD-Adapter-SDSQUAR-016G-GN6MA/dp/B073K14CVB/ref=sr_1_4?s=electronics&ie=UTF8&qid=1548881973&sr=1-4&keywords=16gb+memory+card	₨300.00		₨300.00
6 HDMI cable	https://www.amazon.in/WireSwipe-HDMI-Male-Cable-Black/dp/B01332A05G/ref=sr_1_2?s=electronics&ie=UTF8&qid=1548882039&sr=1-2&keywords=hdmi+cables	₨120.00	₨103.00	₨17.00
7 3-axis digital accelerometer ADXL345	https://www.electronicscomp.com/adxl345-triple-axis-linear-accelerometer?gclid=CjwKCAiAs8XiBRAGEiwAFyQ-epR6nvhilp7RFLSJTSXyB56YXGZqXti55rrYR2MVIxTIHdAFxdVABxoC_tsQAvD_BwE	₨500.00	₨825.00	-₨325.00
8 ☐ **Other Circuit parts**		**₨642.00**	**₨346.00**	**₨296.00**
9 LTC6910-1 Amplifier and Linear ICs / Instrumentation	Local shops	₨320.00	₨346.00	-₨26.00
10 74LVC4245a Logic ICs / Receivers, Transceivers	Local shops	₨118.00	₨0.00	₨118.00
11 ADS820U Data Converters / Analog to Digital Converter ICs	Local shops	₨128.00	₨0.00	₨128.00
12 SN7406 Logic ICs / Gates and Inverters	Available in TLC	₨76.00	₨0.00	₨76.00
13 AD633 Amplifier and Linear ICs / Multipliers and Dividers	Available in TLC	₨80.00		
14 LTC6903 Frequency Control / Oscillators	Available in TLC	₨320.00		

Software Requirement
☐ Ubuntu MATE (RPi v14.06), OCTAVE GUI
☐ Python.

Schedule - GANTT Chart

#	Machine monitoring system	Sub Tasks	Assignee	Est. Hours	Start Date	Due Date	Task Prog.
0	Team Selection		Ganesh Kumar	–	05/Jan	09/Jan	100%
	Project Title discussion		Dhilipan	–	10/Jan	17/Jan	100%
2	Getting approval from Prof		Ganesh Kumar	–	12/Jan	17/Jan	100%
3	Choosing and finalising topic		Ganesh Kumar	–			100%
4	Evaluation of each topics		Chandra	–			100%
	Pre-Study of the project		Team	–	18/Jan	22/Jan	100%
6	Gist of IoT based Smart Mfg		Team	–	20/Jan	20/Jan	100%
	Brief Study on Research articles		Team	–	22/Jan	30/Jan	66%
8	IEEE papers		Ganesh Kumar	–	20/Jan	20/Jan	0%
9	Articles		Unassigned	–	22/Jan	24/Jan	100%
10	Interesting articles		Unassigned	–	27/Jan	29/Jan	100%
11	Project Proposal		Team	–	31/Jan	31/Jan	0%
	Getting ready with Vibration & Accoustics		Unassigned	–	01/Feb	05/Feb	0%
13	FFF transform eqns.		Unassigned	–	02/Feb	03/Feb	0%
14	Time domain to freq. domain conversations		Unassigned	–	02/Feb	05/Feb	0%
	Field study of Machinery defects		Unassigned	–	09/Feb	11/Feb	0%
16	Possible visit to CNC, Milling in Campus		Unassigned	–	07/Feb	09/Feb	0%
17	Understanding the Machinery defect		Unassigned	–			0%
	Devising a Experimental Set-up to study Defects		Unassigned	–			0%
19	Selection of parameters to study		Unassigned	–			0%
20	Parameters identification using hardware		Unassigned	–			0%
	Designing the experiment		Unassigned	–			0%
22	Design Matrix		Unassigned	–			0%
23	Adapting to existing machines		Unassigned	–			0%
	Hardware implementation		Unassigned	–	07/Jan	07/Jan	0%
25	Choosing of right hardwares		Unassigned	–			0%
26	Studying the datasheets of Sensors & IC used		Unassigned	–	07/Jan	07/Jan	0%
27	Circuit diagram & Wiring Schema		Unassigned	–			0%
28	Frugal Development		Unassigned	–			0%
29	Alt. resources mapping		Unassigned	–			0%
	Software Implementation		Unassigned	–			0%
31	Raspberry Pi basics brush up		Unassigned	–			0%
32	Python code for data collection from sensors		Unassigned	–			0%
33	GUI for displaying the results		Unassigned	–			0%
	Model Setup running		Unassigned	–			0%
35	Testing using predefined data		Unassigned	–			0%

Our Ask

Mentorship from experts in this area :

● Idea -> Valid Prototyping

● Sourcing of components needed

● Need more clarity on HOW - MECHANICAL VIBRATIONS - WORK?

Academic aid :

● Workspace for us to setup the environment

● Access to Power machine labs for the study of machines

IIITDM
KANCHEEPURAM

IIITD&M
Kancheepuram