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# A Review Paper On: Wireless Bridge Sensors for Monitoring the Health Status of Highway Bridges & Energy Harvesting

Mr. Mangesh Thakur [1], Prof. Bhalchandra Chikate[2], Mr. Anil Tabade[3]
[1] *Department of EXTC J.D.I.E.T Yavatmal, Maharashtra, India*
[1, 2, 3] *Sant Gadge Baba Amaravati University*

***Abstract: This paper provides survey on wireless bridge sensors for monitoring the health status of highway bridges & energy harvesting. Now days we required to overcome the bridge accidents which causes maximum due to bad condition of bridges that we can't monitor time to time so here we used permanently installed sensors networks at below the bridge and passing traffic over the bridge create vibration that will converted into usable electric energy for the system and using the concept of energy harvesting.***

***Keywords: Highway bridge, energy harvesting, structural health monitoring, bridge sensors, piezoelectric energy harvesters.***

## I. INTRODUCTION

Today we need to continuous monitor the health status of bridges. That now day's accidents are increases on the bridges that cause due to the bad condition of bridge that we can't monitor time to time. So in this paper we used the permanently installed bridge sensors that check the overall bridge health status and give information to us time to time that may lead to failure of accidents by early reporting. Also here the passing traffic over bridge create vibration that will convert into the usable electric energy for the system by means of a electromagnetic generator that allows harvesting of a 12.5mw of power. It also include the power generator and smart algorithm for energy conversion. Finally in this paper the wireless system is operated by piezoelectric harvested energy that creates from bridge vibration which is installed in rural highway bridges [1].

## II. LITERATURE SURVEY

Some authors are describing the characteristics of bridge vibration.

The author Maser, K., Egri & et al. [2] describes the wireless sensor nodes perform the useful tasks of structural health monitoring. The power requirement of a sensor node depend both on the type of utilized sensor and architecture of the node and in turn define power requirements for the energy harvester.
The author Straser, E.G., & et al.[3] describes the three assumptions first the bridge vibrations can be characterized highly non stationary with traffic excitation creating the bursts of vibration which persist for several seconds and very low levels of vibration between the bursts. Second, the vibration levels at supports are minimal and reach the maximum at the middle of the span. Third, natural frequencies of vibration excited by traffic will depend on structural geometry.
The author E. Sazonov, & et al. [4] describes the amplitude of displacement of a bridge vibration characteristics at a certain frequency depends on a specific location along the girder and may require modal analysis for optimal selection of fundamental frequencies used for harvesting.

## III. THE OPERATION AND POWER REQUIREMENT OF WIRELESS SENSOR NODES

The wireless sensor node is very useful tasks of structural health monitoring. The power requirement of a sensor node depend both on the type of utilized sensor and in turn define power requirements for the energy harvester. The central part is a microcontroller which is responsible for three essential tasks: control of impedance matching and energy conversing of circuit and power controlling of the sensors and reading of the sensors information and data and power controlling of a wireless interface and transmission of

sensors reading. The impedance matching energy conversion circuit was designed to maximize energy delivery from the harvester by presenting a near-optimal load to the linear generator.

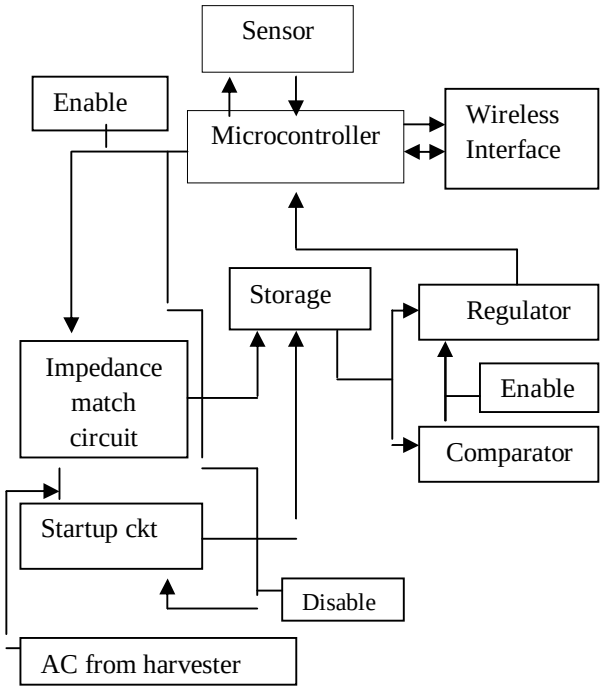


Fig.1: Block diagram of a wireless sensor node.

## IV. ENERGY REQUIREMENT OF A WIRELESS NODE COMPONENT

Energy requirements by components of a wireless sensor node operating at 3V.

| component | Current consumption, mA | Energy uJ |
|---|---|---|
| uc startup(8Mhz) | 2.7 | 0.486 |
| uc operation(LPM3) | ~1.0 | 1.5 |
| Sensor | 0.035 | 0.052 |
| Radio Startup | 0.4 | 3.9 |
| Radio transmission (6 bytes ,2 Mbps, No ACK) | 11.3 | 3.254 |
| Total | | 9.192 |

Table 1: Energy requirement of a wireless node component

The total energy required from the energy harvester to generate a single measurement/transmission is approximate 9uJ. Are shown in table 1.

## V. ENERGY HARVESTING DEVICE

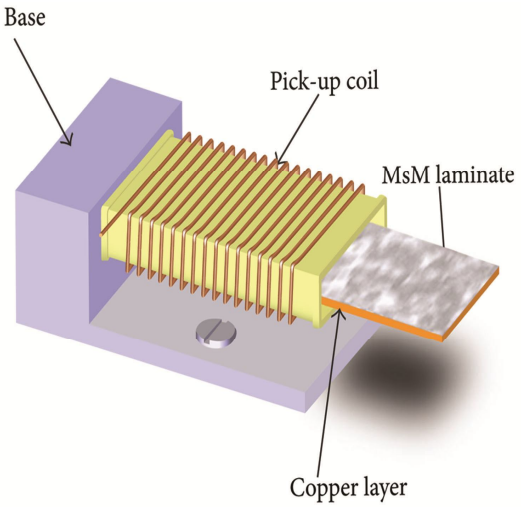


Fig. 2: MsM Prototype energy harvesting Device [5].

The vibrational energy harvesting system for a wireless sensor nodes or device designed for the safety of operators using machinery to tow trailers was developed by Dondi & et al. [6]. A harvester was a PZT cantilever rotate to resonate at 112Hz vibrations of a agricultural baler used for case study. The vibration strengths range from 0.5 to 1.0 g's, the energy harvester will generate 23 $\mu$W to 850$\mu$W of the usable power.

The magnetostrictive material (MsM) energy harvesters rely on Villari effect whereas vibration induced strain of the material produces the change in its magnetization. Wang and Yuan [7].

## VI. INSTALLATION OF SENSORS AND MONITORING THE BRIDGE HEALTH STATUS

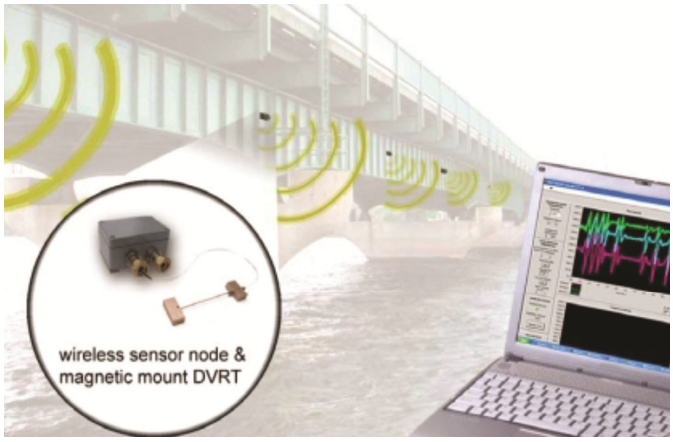


Fig. 3: Installation of distributed sensors and bridge Health monitoring.

Wireless network Supports quick installation of distributed sensors

Sensor installations on a bridge depend upon the type and construction of bridge and also the most vibrating area of the bridge i.e. depend upon the girder displacement of the bridge. The Health status of the the bridge that will continue monitor and send

information and data through wireless network. The wireless network supports detailing inspection and periodic evaluation and long-term monitored.

## VII. CONCLUSION

This Paper proposed the wireless bridge sensors system for applications of bridge health monitoring. The sensor relies on harvesting the energy of bridge displacements created due to passing traffic over the bridge. And it proposed the valuable approach which can significantly support an Installation of sensor network over the bridge and actual health monitoring.

## VIII. FUTURE SCOPE

Future work will developed a energy harvesting system for gained a significant rolled and interest in recent years due to the widespread availability of inexpensive, low cost and low power RF chipsets and microcontrollers that could form the core of a wireless bridge sensor system.

## IX. ACKNOWLEDGEMENT

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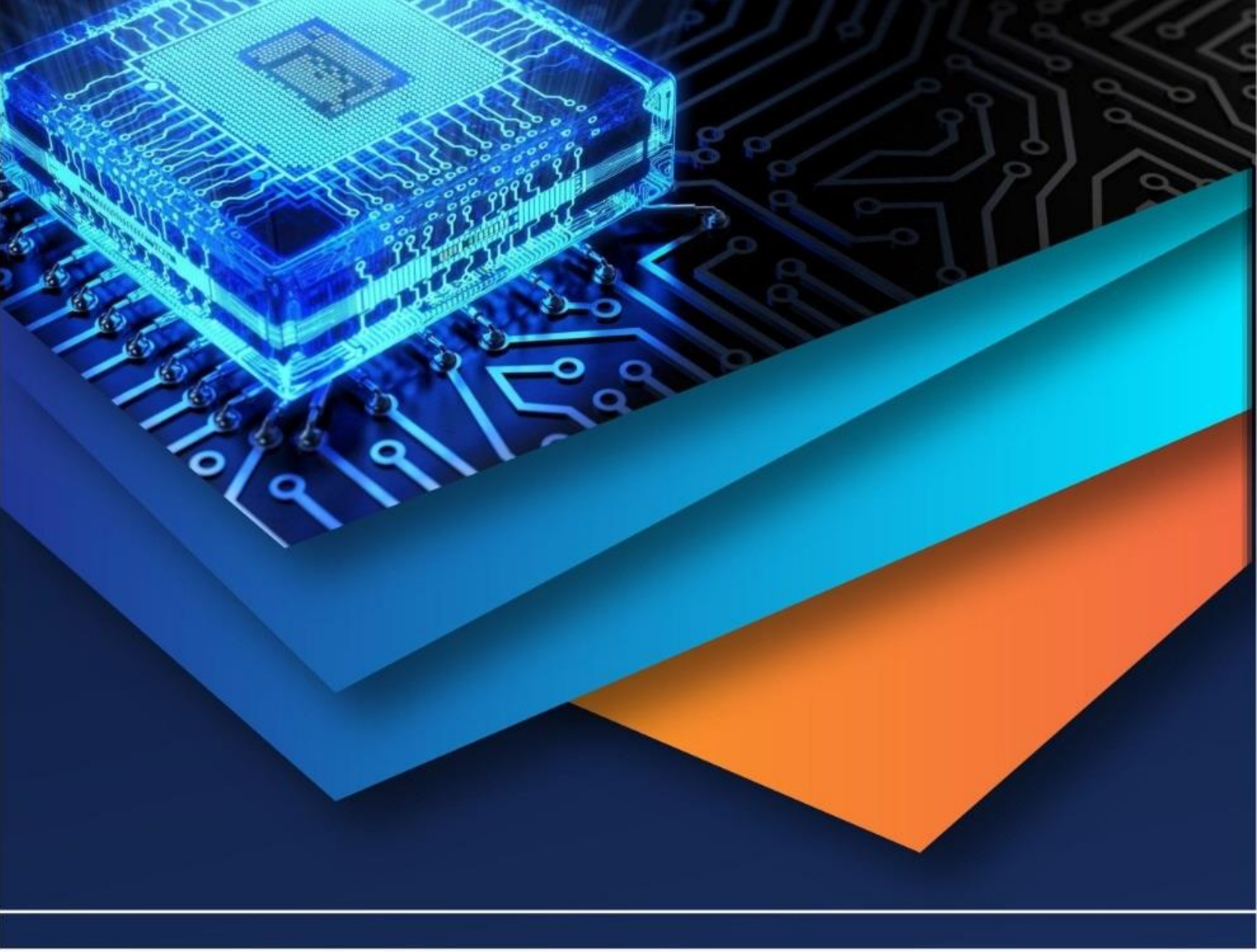

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