# DEVELOPMENT OF AN IC-BASED VIBRATION DETECTION AND MONITORING SYSTEMS

**ECB1204- ANALOG INTEGRATED CIRCUIT**

**A PROJECT REPORT**

***Submitted by***


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***in partial fulfillment for the award of the degree***

***of***

**BACHELOR OF ENGINEERING**

***in***

**ELECTRONICS AND COMMUNICATION ENGINEERING**


**K.RAMAKRISHNAN COLLEGE OF TECHNOLOGY**

(An Autonomous Institution, Affiliated to Anna University Chennai and Approved by AICTE, New Delhi)

**SAMAYAPURAM, TIRUCHIRAPPALLI – 621 112**


DECEMBER, 2024

# K. RAMAKRISHNAN COLLEGE OF TECHNOLOGY (AUTONOMOUS)

**SAMAYAPURAM, TIRUCHIRAPPALLI– 621 112**

## BONAFIDE CERTIFICATE

Certified that this project report titled **" DEVELOPMENT OF AN IC-BASED VIBRATION DETECTION AND MONITORING SYSTEMS "** is the bonafide work of **MOHAMMED BASITH M (2303811710621084) , POSHITHKUMAR G (2303811710621078) , RAJARAJAN D (2303811710621084)** who carried out the project under my supervision. Certified further, that to the best of my knowledge the work reported herein does not from part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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Submitted for the viva-voce examination held on ………………

**INTERNAL EXAMINER**

**EXTERNALEXAMINER**

# DECLARATION

We jointly declare that the project report on **"VIBRATION DETECTOR"** is the result of original work done by us and best of our knowledge, similar work has not been submitted to **"ANNA UNIVERSITY CHENNAI"** for the requirement of Degree of **BACHELOR OF ENGINEERING**. This project report is submitted on the partial fulfillment of the requirement of the award of Degree of **BACHELOR OF ENGINEERING**.

**Signature**

MOHAMMED BASITH M

POSHITH KUMAR G

RAJARAJAN D

Place : Samayapuram

Date :

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# CHAPTER 1

## PROBLEM STATEMENT

In industrial environments, equipment failure is a major concern, leading to operational downtime, financial losses, and compromised safety. One of the primary causes of machinery breakdowns is excessive vibration, which can stem from several underlying issues such as misaligned components, unbalanced rotating parts, loosened fasteners, or worn-out bearings. Despite its critical impact, the timely detection of vibrations remains a challenge, particularly for small and medium-sized enterprises (SMEs). Many rely on outdated manual inspection methods or costly high-end monitoring systems, both of which are either ineffective or financially unviable for routine use.

Delayed detection of abnormal vibrations can have significant consequences. Equipment malfunctions often escalate, causing unscheduled downtime, productivity loss, and costly repairs. Additionally, the lack of real-time monitoring systems increases the risk of catastrophic mechanical failures, posing safety threats to personnel. Furthermore, reactive maintenance—addressing problems only after they occur—leads to higher operational costs compared to proactive approaches that emphasize early issue detection and resolution.

The root causes of excessive vibrations are varied but common in industrial operations. Misaligned components, often a result of wear and improper installation, lead to increased wear and overheating. Unbalanced rotating parts, such as motors and turbines, reduce efficiency and strain the machine's bearings. Loose fasteners or bolts, caused by continuous operation or thermal expansion, destabilize equipment, while worn bearings or gears create excessive friction and overheating. These issues, if undetected, compromise the longevity and reliability of industrial machinery.

To address these challenges, we propose a cost-effective and portable vibration detection system using an NE555 timer, vibration analyser and other basic electronic components. The system provides an immediate visual alert via an LED whenever vibrations occur, enabling users to identify and address issues proactively. By offering an affordable and straightforward alternative to expensive monitoring tools, this solution empowers industries, especially SMEs, to enhance their maintenance practices, ensure operational safety, and minimize downtime effectively.

## 1.1. BACKGROUND OF THE WORK

Vibration detection plays a pivotal role in various fields, particularly in industrial maintenance and safety. In mechanical systems, vibrations are often early indicators of underlying issues such as misalignment, unbalanced components, or mechanical wear. Left unaddressed, these issues can escalate into major failures, resulting in costly repairs, unplanned downtime, and potential safety hazards. Traditionally, industries relied on manual inspection and mechanical vibration meters, which were labor-intensive, less precise, and unsuitable for real-time monitoring.

With advancements in technology, high-end vibration monitoring systems, such as those utilizing accelerometers and sophisticated software, have emerged. However, these solutions are often prohibitively expensive and complex, making them inaccessible for small and medium-sized enterprises (SMEs) or for applications requiring cost-efficiency and simplicity. This gap highlights the need for an affordable, reliable, and easy-to-deploy vibration detection system that can provide basic yet effective monitoring capabilities.

Our work aims to address this gap by developing a compact and cost-effective vibration detector using a simple electronic circuit. Leveraging widely available components like the NE555 timer and vibration analyser, this project demonstrates how basic electronics can meet the needs of industries seeking practical solutions for real-time vibration detection. By providing a visual indication of abnormal vibrations, this system offers a proactive approach to equipment monitoring, enhancing efficiency and safety without the financial burden of high-end alternatives.

# CHAPTER 2

# DESIGN PROCEDURE

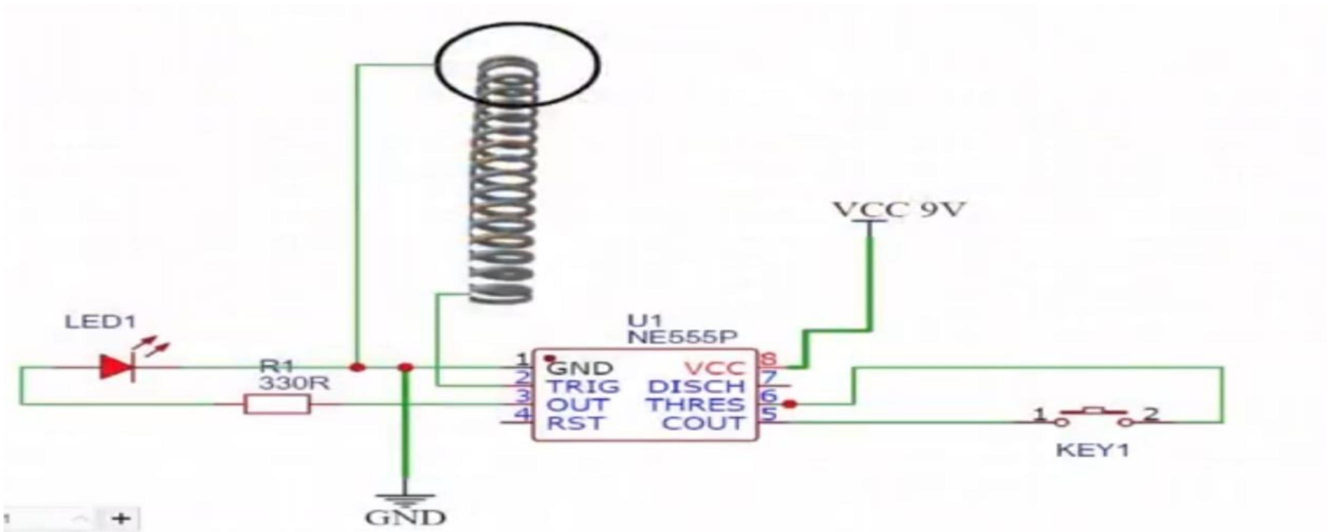



Figure 2.1 Circuit diagram of vibration detector

## 2.1 COMPONENTS DESCRIPTION

### 2.1.1 NE555 Timer:


Figure 2.1 NE 555 TIMER

The **NE555 Timer** is a versatile integrated circuit that can be used in various modes, including monostable and astable. In this project, we use the NE555 timer in **monostable mode**. This means that when the timer receives a trigger signal, it outputs a high pulse for a specific duration, then returns to low. The NE555 timer is essential for controlling the timing of the LED based on the vibration signal received from the vibration analyser. It can generate precise time delays, which is why it's perfect for making the LED glow for a short period when vibration occurs.

### 2.1.2 LED (Light Emitting Diode):

Figure 2.2 LED

The **LED** is a semiconductor device that emits light when current flows through it in the forward direction. In this project, the LED serves as an indicator to show that vibration has been detected. When the NE555 timer sends a high signal to the LED, it lights up. The LED's brightness and behavior are controlled by the timer, and the LED will stay on for a set duration (based on the timer's configuration) before turning off.

### 2.1.3 Resistor:

Figure 2.3 330-ohm RESITOR

The **330-ohm resistor** is used to limit the current flowing through the LED. LEDs are sensitive to current, and if too much current flows through them, they can burn out. The resistor ensures that the LED receives just the right amount of current to light up without damaging it. The 330-ohm value is a typical choice to protect the LED in a 9V circuit.

### 2.1.4 9V Battery:

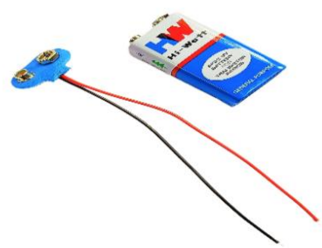


Fig 2.4 BATTERY

The **9V battery** is the power source for the entire circuit. It supplies the necessary voltage to run the NE555 timer and power the LED. The battery is connected to the breadboard's power rails, providing both the positive and negative voltages required by the circuit. Since the circuit uses the NE555 timer and an LED, which both require a stable voltage supply, the 9V battery is ideal for this setup.

### 2.1.5 Vibration analyser

Figure 2.5 ANALYSER

The **vibration analyser** is used to detects vibration or movement. When the analyser detects vibration, it momentarily closes the circuit and sends a signal to the trigger pin of the NE555 timer. This action triggers the timer, causing it to output a high pulse that turns on the LED. The vibration analyser essentially acts as the input to the system, allowing the circuit to respond to physical vibrations.

## 2.2 WORKING PRINCIPLE OF VIBRATION DETECTOR

The vibration detector project is designed to identify mechanical vibrations and provide a visual indication using an LED. It employs an NE555 timer, configured in monostable mode, to process the signal generated by a simple vibration sensor consisting of a nail placed on a spring. When vibrations occur, the movement of the nail creates a momentary electrical connection that acts as a trigger for the NE555 timer. Upon receiving this trigger, the NE555 generates a stable output pulse, causing the LED to glow, thereby indicating the presence of vibrations. Additional components, such as a 330-ohm resistor, are used to limit the current to the LED, ensuring safe operation. Powered by a 9V battery and built on a breadboard for ease of assembly, this circuit effectively demonstrates the principle of converting mechanical vibrations into an electrical response for real-time detection.

## 2.3 CALCULATION

For a red LED with Vf =2V and If =20 mA

$$R = \frac{V_s - V_f}{I_f} = \frac{9V - 2V}{0.02A} = \frac{7V}{0.02A} = 350\,\Omega$$

Since 330Ω is a standard resistor value close to 350Ω, it is chosen. This slight difference doesn’t significantly affect the LED's performance but ensures it is safe and bright.

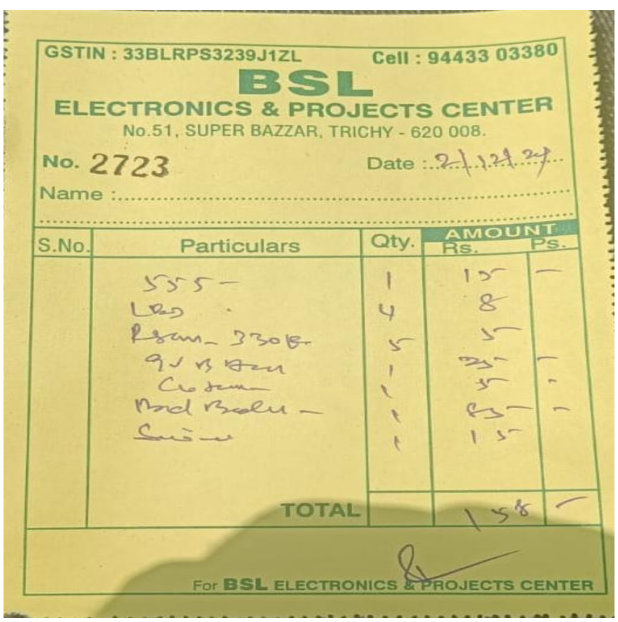
# CHAPTER 3

# COST OF THE COMPONENTS

| COMPONENT | QUANTITY | COST (APPROX.) |
|---|---|---|
| IC NE555 | 1 | 20 |
| LED 5mm | 1 | 5 |
| RESISTOR(330 ohm) | 1 | 5 |
| 9v BATTERY | 1 | 30 |
| BREAD BOARD | 1 | 60 |
| SPRING | 1 | 15 |
| NAIL | 1 | 5 |
| TOTAL | | 140 |

3.1 TABLE FOR THE COST OF THE COMPONENT

### 3.1 COMPONENTS BILL IMAGE



GSTIN : 33BLRPS3239J1ZL Cell : 94433 03380

BSL

ELECTRONICS & PROJECTS CENTER

No.51, SUPER BAZZAR, TRICHY - 620 008.

No. 2723 Date :

Name :

| S.No. | Particulars | Qty. | AMOUNT Rs. | Ps. |
|---|---|---|---|---|
| | 555 | 1 | 15 | |
| | LED | 4 | 8 | |
| | | 5 | 5 | |
| | | 1 | | |
| | | 1 | 35 | |
| | | 1 | | |
| | | 1 | 15 | |
| | TOTAL | | 158 | |

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# CHAPTER 4

# RESULT AND DISCUSSION

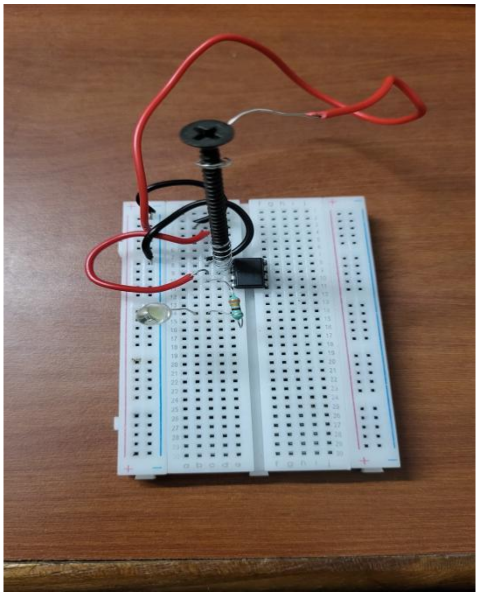

**Fig 4.1 CIRCUIT DEMO**

The vibration detector project effectively demonstrates the use of basic electronic components, particularly the NE555 timer, in creating a functional and reliable vibration detection system. The system works by using a vibration analyser to detect any physical movement or vibration. When the vibration occurs, the switch sends a signal to the NE555 timer, which then generates a high pulse, triggering the LED to light up for a short period. After this period, the LED automatically turns off, providing a clear and immediate visual indication of the detected vibration.

The circuit performs well in practical testing, with the LED accurately responding to various levels of vibration. The NE555 timer's ability to produce a precise time delay allows for controlled and consistent operation of the LED, ensuring that the indicator remains lit for the desired amount of time. The timing duration can be fine-tuned by adjusting the values of the external resistor and capacitor, offering flexibility in how long the LED stays on after vibration detection.

The project also highlights the importance of the vibration analyser, which acts as the key in this system. The sensitivity of the analyser can vary, and this affects the responsiveness of the system. A more sensitive switch would allow the system to detect even minor vibrations, while a less sensitive one would only activate the detector in the presence of stronger vibrations. By experimenting with different types of vibration switches, the performance of the system can be optimized for specific applications.

Another important aspect of the project is the use of a 9V battery as the power source. This provides a convenient and portable solution for powering the circuit. However, considering the energy consumption of the circuit, the project could be further optimized for energy efficiency, especially if it were to be used in continuous or long-term applications. Possible improvements might include using low-power components or adding a power-saving feature.

In conclusion, the vibration analyser project is a simple yet effective demonstration of how analog components can be combined to create a useful sensor-based system. It offers a hands-on learning experience with applications in real-world scenarios, such as security systems, motion detection, or even in industrial environments where monitoring vibrations is critical. The project could be expanded by integrating more sophisticated sensors, adding an audible alarm, or even connecting it to a microcontroller for more complex control and feedback.

## 4.1 APPLICATION

The vibration detector has a wide range of practical applications across various domains, including security systems, industrial equipment monitoring, home automation, and vehicle monitoring. In security systems, the vibration detector can be integrated to detect unauthorized movement or tampering, such as vibrations caused by a break-in attempt. Placed on doors or windows, the sensor can trigger alarms or notifications to alert homeowners or security personnel of potential threats. This adds an extra layer of security to traditional surveillance systems. In industrial equipment monitoring, vibration sensors are crucial for detecting signs of malfunction or wear in machinery. Excessive vibrations often signal issues like misalignment, imbalance, or bearing wear, enabling predictive maintenance. This helps reduce downtime and prevents costly equipment failures by addressing problems before they lead to breakdowns. In home automation, vibration detectors can be used to monitor events such as door or window openings, or detect motion in specific areas of the home. These sensors can trigger actions like turning on lights, adjusting the thermostat, or activating security systems, improving energy efficiency and convenience. Finally, in vehicle monitoring, vibration sensors can detect unusual vibrations caused by engine malfunctions or impacts, such as in the case of a collision. These sensors can trigger alerts, assist with predictive maintenance, or activate safety systems, enhancing vehicle reliability and safety. Overall, vibration detectors offer valuable solutions for improving security, maintenance, and automation across a wide variety of fields.

## 4.2 ADVANTAGES

The vibration detection circuit offers several key advantages, making it suitable for a variety of applications. One of its primary strengths is its versatility and customizability. By adjusting the timing components, such as the resistor and capacitor, users can easily customize how long the LED stays on after vibration detection. This flexibility makes it ideal for different use cases, whether it's for a short alert or a longer indication of detected vibrations. Additionally, the circuit is designed with low power consumption in mind, operating on a 9V battery. This makes the system highly portable and suitable for mobile or remote applications where a constant power source might not be available. Despite its efficiency, the low power requirement ensures that the battery lasts for a reasonable period before needing replacement. Furthermore, the project is easy to build and understand, making it an excellent learning opportunity for beginners in electronics. It helps newcomers grasp the functionality of essential components like the NE555 timer, LEDs, and resistors. The circuit is simple enough to assemble on a breadboard, requiring no advanced knowledge of electronics, and is a great starting point for anyone looking to get into basic circuit design and experimentation.

# CHAPTER 5

# CONCLUSION

In conclusion, the vibration detector project effectively integrates basic electronic components such as the NE555 timer, LED, and vibration analyser into a functional system that serves as an excellent example of analog circuit design. By utilizing the NE555 timer in monostable mode, the circuit successfully detects vibrations and provides a clear, immediate visual indication through the LED. The simplicity of the components used, along with the flexibility of the design, makes this project an ideal starting point for beginners in electronics, offering hands-on experience with fundamental concepts like timing circuits, sensors, and power management. Furthermore, the project's adaptability allows for a range of potential applications, from home security systems to industrial machinery monitoring, where vibration detection is crucial. The system can easily be modified for different environments by adjusting the sensitivity of the vibration analyser or changing the timing components to suit specific needs. Additionally, the low cost and ease of assembly make it an accessible and practical solution for detecting vibrations in a variety of real-world scenarios. With the ability to expand and integrate more complex features, such as wireless communication or multiple sensor inputs, the vibration detector project offers a solid foundation for further development. Overall, this project not only provides valuable learning opportunities but also demonstrates the practical use of basic electronics in creating a functional, adaptable, and cost-effective solution for vibration detection.