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Condition Monitoring of Bikes using IOT

Pranav Dalvi

Undergraduate Student

Department of Mechanical Engineering

Shivajirao S. Jondhale College of Engineering, Dombivli(E), India.

Kaiyum Mujawar

Undergraduate Student

Department of Mechanical Engineering

Shivajirao S. Jondhale College of Engineering, Dombivli(E), India.

Prathamesh Bhingare

Undergraduate Student

Department of Mechanical Engineering

Shivajirao S. Jondhale College of Engineering, Dombivli(E), India.

Aaradhya Shigwan

Undergraduate Student

Department of Mechanical Engineering

Shivajirao S. Jondhale College of Engineering, Dombivli(E), India.

Tushar Pokharkar

Assistant Professor

Department of Mechanical Engineering

Shivajirao S. Jondhale College of Engineering, Dombivli(E), India.

Abstract : In recent years, the integration of Internet of Things (IoT) technology into various domains has revolutionized how we monitor and manage assets. This paper presents a novel IoT-based condition monitoring system tailored specifically for motorcycles, aiming to improve both rider safety and vehicle performance. The proposed system incorporates a network of sensors strategically positioned on critical components of the motorcycle, including the engine, coolant. These sensors continuously collect real-time data on parameters such as engine temperature, RPM, brake pressure, tire pressure, and lean angle. The data is wirelessly transmitted to a centralized control unit, which employs advanced analytics and machine learning algorithms to process and analyse the information.

By monitoring key metrics in real-time, the system can detect deviations from normal operating conditions, identify potential faults or malfunctions, and provide timely alerts to the rider through a smartphone application or dashboard interface. These alerts enable proactive maintenance scheduling and help prevent catastrophic failures, thereby enhancing rider safety and reducing the risk of accidents. Furthermore, the IoT-enabled condition monitoring system facilitates predictive maintenance by predicting component failures based on data trends and usage patterns. This predictive approach minimizes downtime and maintenance costs while maximizing the lifespan and reliability of motorcycle components. Additionally, the system offers valuable insights into rider behaviour, road conditions, and vehicle performance, which can be utilized by manufacturers, insurers, and transportation authorities to improve product design, develop safer riding practices, and enhance overall road safety. In conclusion, the proposed IoT-based condition monitoring system represents a significant advancement in motorcycle technology, offering a smart and proactive approach to enhance safety, performance, and reliability for riders and manufacturers alike.

Keywords: IoT Sensors, Bike Health Monitoring, Predictive Maintenance, Real Time Data Acquisition, Vibration Analysis, Temperature Sensors, Accelerometers, Wireless Connectivity, Cloud Based Analytics, Fault Detection.

I. INTRODUCTION

Over the past few years, IOT has become one of the most important technologies of the 21st century. The Internet of Things (IOT) is a system of interrelated computing devices, mechanical and digital machines that are provided with unique identifiers embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. IOT provides the ability to transfer data over a network without requiring human-to-human or human-to- computer interaction.

The internet of things is becoming an increasingly growing topic of conversation both in workplace and outside of it. Broadband internet connection has become more widely available almost everywhere in the world. The costs involved in broadband internet connection are reducing almost every day and hence the cost of connecting to the internet has drastically been reduced. Additionally, more devices are being connected using Wi-Fi technology removing the wired complexity and costs involved giving wireless freedom for internet connectivity. So hence, more and more devices are being built everyday with capability to connect to the internet, share and send some data to internet and receive any data coming from internet.

Thus, IoT is a concept of basically connecting any device with an on and off switch to the internet. This device can be anything from cell phone, coffee vending machine, water geyser, microwave oven, lamps, room lights and anything we can think of. It's going to be beyond the connected computers term which is in use for so long term. IOT is going to be a giant network where every device imaginable would be connected to internet.

The user of system can be sitting anywhere in the world and control his home appliances or industrial processes by just looking on his computer screen where he can open a web browser and put address of his device. The embedded device may serve an HTML page of its own just like a web site page loads where user can see any data related to the device.

Similarly, there are large numbers of applications where data analysis can be done in a much smarter way. In many cases, the embedded device connected to internet does not serve HTML page, but simply send the parameters that are sensed using HTTP requests to the server and it's up to the server-side programming to analyze data properly and arrange in a way where user can effectively read and observer the data.

A motorcycle is a two or three-wheeled motor vehicle steered by a handlebar from a saddle-style seat. Motorcycle design varies greatly to suit a range of different purposes: long distance travel, commuting, cruising, sport (including racing),and offroad riding. Motorcycling is riding a motorcycle and being involved in other related social activities such as joining a motorcycling club and attending rallies. The 1885 Daimler Reitwagen made by Gottlieb Daimler and Wilhelm Maybach in Germany was the first internal combustion, petroleum -fueled motorcycle. In 1894, Hildebrand & Wolfmuller became the first series production motorcycle. Globally, motorcycles are comparably popular to cars as a method of transport. In 2021, approximately 58.6 million new motorcycles were sold around the world, fewer than the 66.7 million cars sold over the same period.

In 2022, the top four motorcycle producers by volume and type were Honda, Yamaha, Kawasaki, and Suzuki. In developing countries, motorcycles are considered utilitarian due to lower prices and greater fuel economy. Of all the motorcycles in the world, 58% are in the Asia-Pacific and Southern and Eastern Asia regions, excluding car-centric Japan. The first internal combustion, petroleum fueled motorcycle was the Daimler Reitwagen. It was designed and built by the German inventors Gottlieb Daimler and Wilhelm Maybach in Bad Cannstatt, Germany, in 1885. This vehicle was unlike either the safety motorcycles or the boneshaker bicycles of the era in that it had zero degrees of steering axis angle and no offset, and thus did not use the principles of bicycle & motorcycle developed nearly 70 years earlier. Instead, it relied on two outrigger wheels to remain upright while turning. The first commercial design for a self-propelled cycle was a three-wheel design called the Butler Petrol Cycle, conceived of Edward Butler in England in 1884. He exhibited his plans for the vehicle at the Stanley Cycle Show in London in 1884. The vehicle was built by the Merryweather Fire Engine company in Greenwich, in 1888.

II. RESEARCH METHODOLOGY

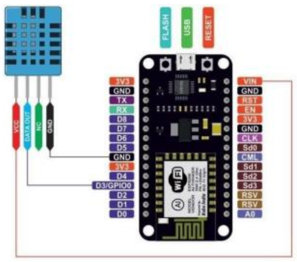


Figure 1.1

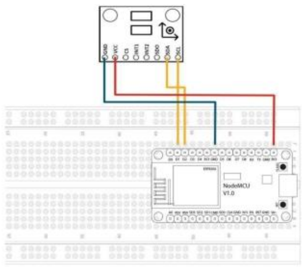


Figure 1.2

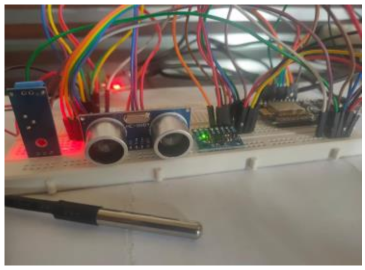


Figure 1.3

Figure 1.1 – DS18B20 connection with ESP8266
Figure 1.2 – MPU 6050 connection with ESP8266
Figure 1.3 – Circuit Connection on Breadboard

Data Collection and Interpretation

Data Collection and storage is one of the important element of our project. The readings received from the sensors are needed to be stored such that they can be used to analyze the performance of the Bike. For this purpose we have used an application called blynk.

Introduction to Blynk application:

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things.

There are three major components in the platform:

Blynk App - allows to you create amazing interfaces for your projects using various widgets we provide.

Blynk Server - responsible for all the communications between the smart-phone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. Its open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.

Blynk Libraries - for all the popular hardware platforms - enable communication with the server and process all the incoming and out-coming commands. Now imagine: every time you press a Button in the Blynk app, the message travels to the Blynk Cloud, where it magically finds its way to your hardware. It works the same in the opposite direction and everything happens in a blink of an eye.

After all the sensors and the data collection is set on needed algorithms, the model is used to monitor the various parameters of the bike i.e. temperature, vibration and coolant level. The Model is attached on the bike in such a way that the temperature sensors is fitted on the wall of the engine, ultrasonic sensor on the top of the coolant tank & accelerometer will be attached to the model itself so when the actual vibration occurs it will be detected by all the sensors. Then the data collected by the sensors is uploaded to the blynk server and then the data is converted into monitoring algorithms set in the program. The converted data is shown in terms of reading in the blynk application interface. These data can be viewed by the rider to get a proper knowledge of their bike parameters based on the current condition. These data is stored to the blynk library and can be reviewed by the user anytime during the maintenance of the bike.

III. RESULTS AND DISCUSSION

3.1 Results of All Parameters

Below are the blynk application interface results which shows 3 Axial Notations i.e. X, Y & Z Axis, Temperature ,Coolant Level, & Vibration.

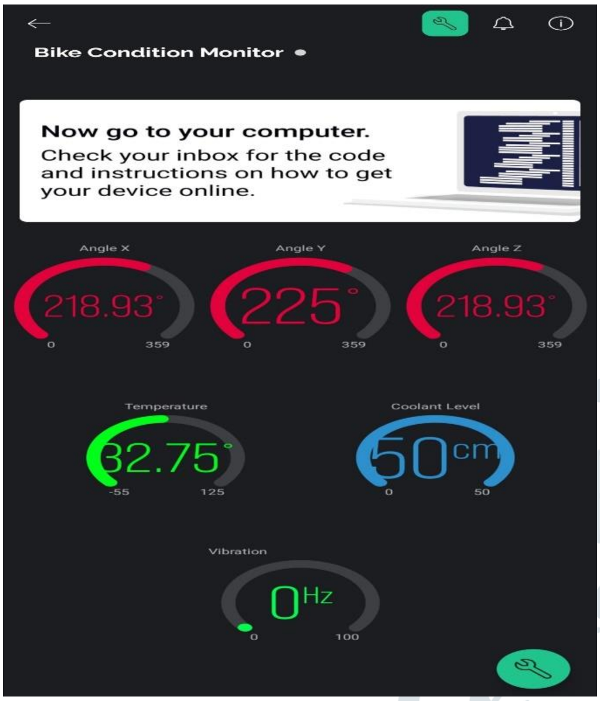


Figure 3.1 : Pulsar after Cold Start

Figure 3.2 : Pulsar after Test Run

Figure 3.3 : R15 after Cold Start

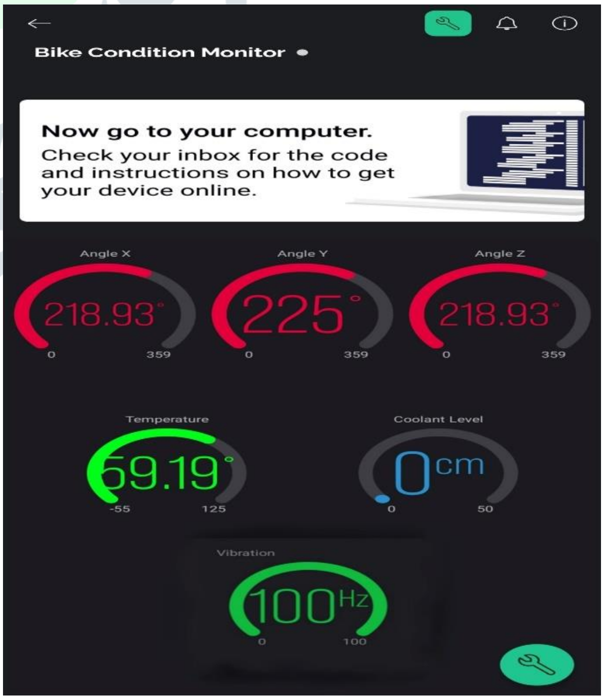
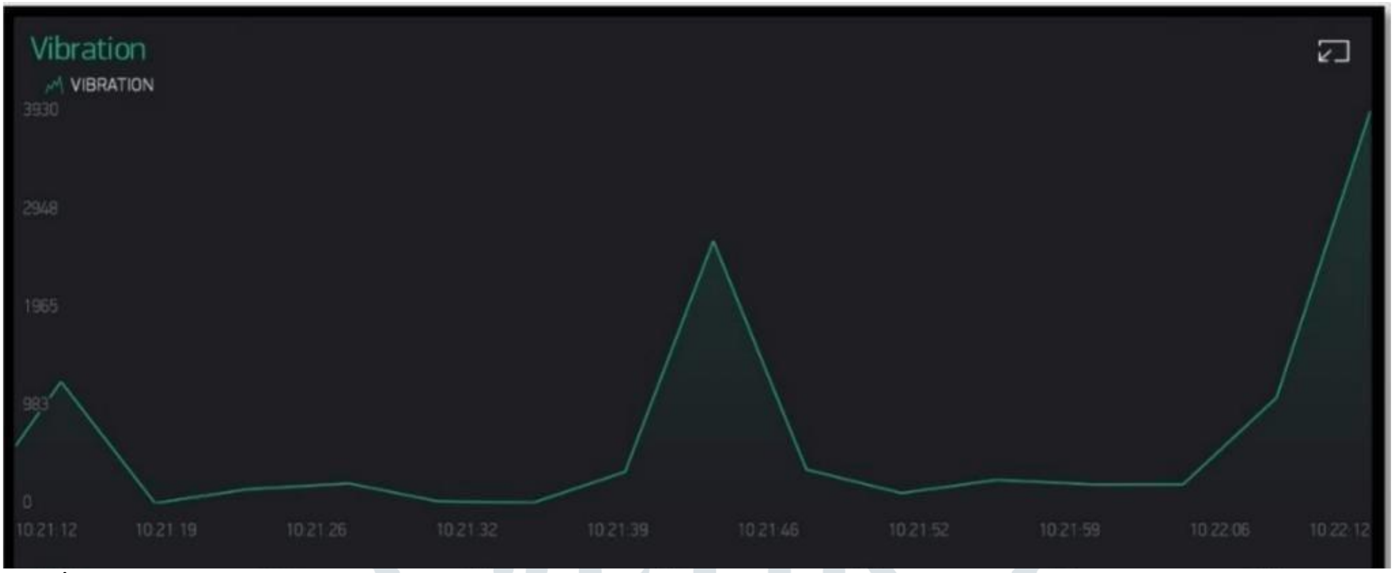


Figure 3.4 : R15 after Test Run

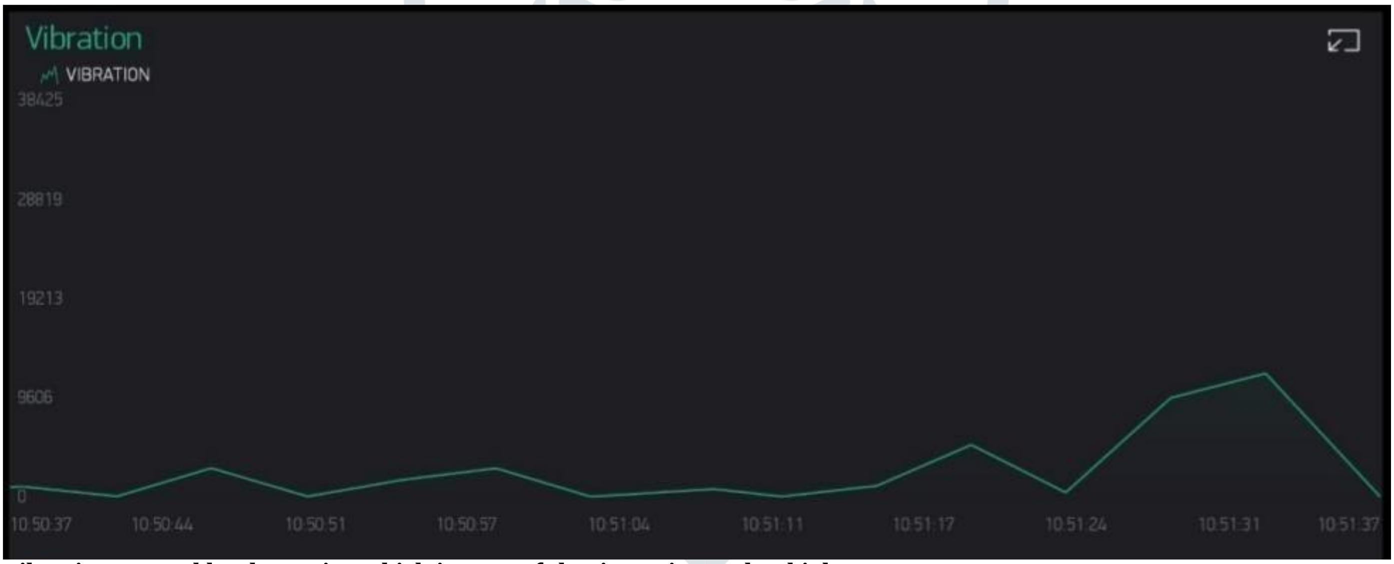
Below is the graph for vibration at the initial stage of bike when it is on cold start, at this stage bike starts of with a high rpm but regains its initial rpm after some time.

When Bike is at normal rpm after the cold start we get a simple graph but still with a small fluctuation due to engine



running

Vibration at the stage of bike when it is in running condition the fluctuations in the graph can be seen which is due to



vibration created by the engine which is most of the time triggered at high rpm.

Table 3.1.1: Temperature, Coolant, Vibration & Axis of the Bike

Table 3.1.1 displayed temperature, coolant level, vibration & axis of the bike displayed by the blynk interface during the study.

Two Bikes were kept under test during the study. There are 3 conditions of bike considered during the study, at Atmospheric Temperature, Cold start & After a Approx 1km Running. The temperature tested under these conditions were 29.75°C, 35.94°C, 59.19°C for Yamaha R15 & 29.75°C, 32.75°C, 69.94°C for Pulsar 150 respectively. The Coolant Level recorded for Yamaha R15 were 4.57 cm & 4.19 for Pulsar 150. The Vibration analyzed were in range and the ranges differed according to the bikes & condition parameters.

	Temperature in (°C)		Coolant Level in (cms)	Vibration in (Hz)	Axis
Yamaha R15	Atmosphere	29.75	4.57	0	X(218)
	Cold Start	35.94		17-100	Y(218)
	After Run	59.19		26-100	Z(218)
Pulsar 150	Atmospheric	29.75	-	0	X(225)
	Cold Start	32.75		11-100	Y(225)
	After Run	69.94		21-100	Z(225)

IV. Conclusion

In this project we have successful grasped the knowledge of IOT & Bikes. Different electronic components like Breadboard, ESP8266, HC-SR 04 (Ultrasonic Sensor), DS18B20 (temperature sensor), SW 420D (Vibration Sensor), MPU 6050 Accelerometer. Esp8266 is the heart of our system. We successfully calibrated all the sensors with respect to the atmosphere at room temperature. We also sent the data to the Blynk server which we used as the IOT medium we were able to check the temperature, vibration and coolant level with help of ultrasonic sensor remotely from our mobile using the Blynk website in different types of indicators like charts or dials. This project gave us lot of knowledge and also got us out of our field from pure mechanical and motivated us to explore the electronics field practically. We also got to learn coding in Arduino software which was quite a challenge. Using IOT in Bikes will definitely increase productivity and monitoring of the Bikes will reduce the chances of break down in the middle of running.

V. Acknowledgment

We are very glad to present project research paper on Condition Monitoring of Bikes using Iot. Many people have contributed directly or indirectly in successfully making of this project. So, we would like to express our gratitude towards them.

We would equally also like to thank our Head of Department Prof V.M Magar & our honourable Principal Dr. P. R. Rodge for their co-operation and valuable guidance.

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