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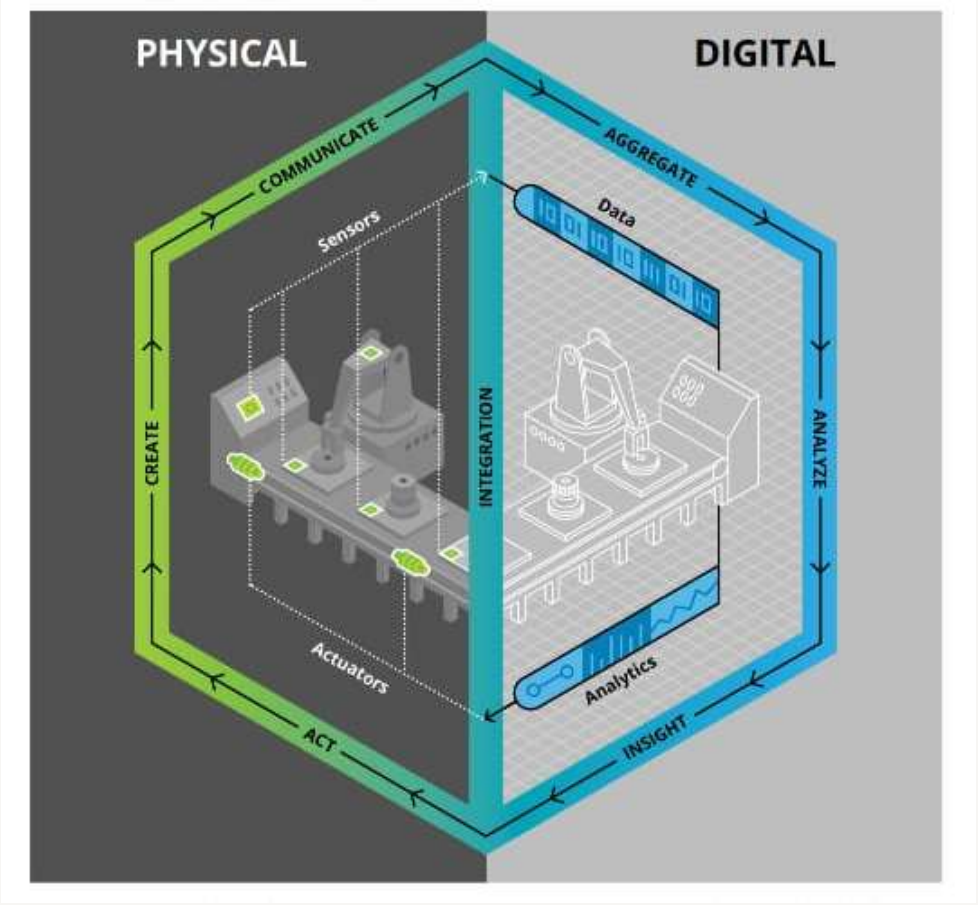
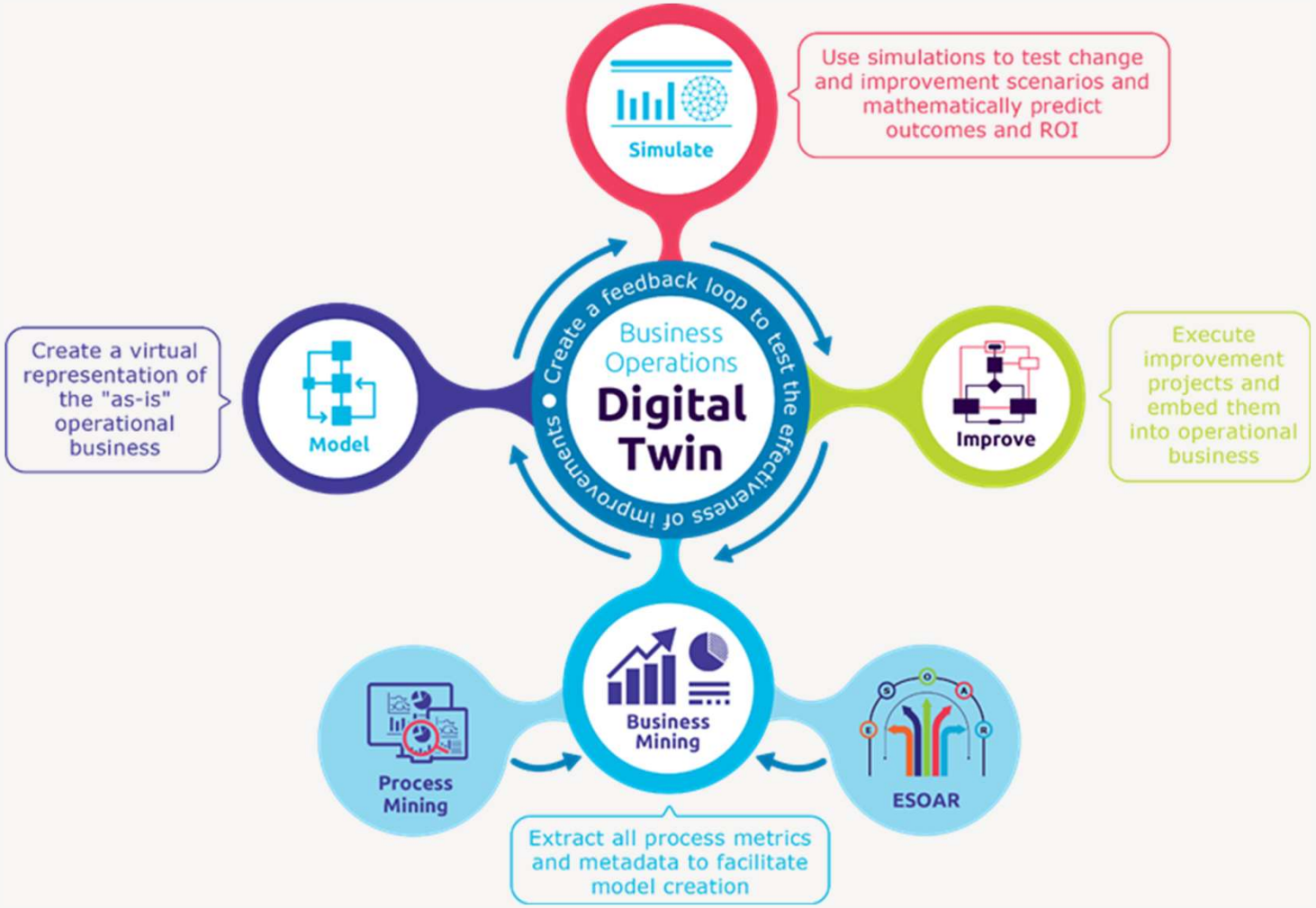
Introduction

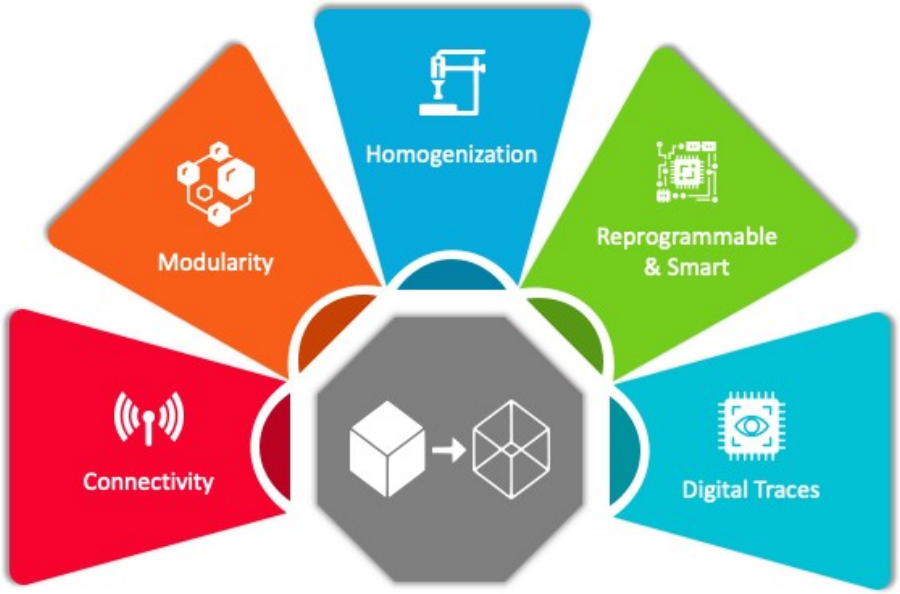
A digital twin is a digital representation of a physical object, process or service. A digital twin can be a digital replica of an object in the physical world, such as a jet engine or wind farms, or even larger items such as buildings or even whole cities.


PHYSICAL
DIGITAL
COMMUNICATE
AGGREGATE
Sensors
Data
CREATE
INTEGRATION
ANALYZE
Actuators
Analytics
ACT
INSIGHT


Simulate
Use simulations to test change and improvement scenarios and mathematically predict outcomes and ROI
Create a feedback loop to test the effectiveness of improvements
Business Operations
Digital Twin
Model
Create a virtual representation of the "as-is" operational business
Improve
Execute improvement projects and embed them into operational business
Business Mining
Process Mining
ESOAR
Extract all process metrics and metadata to facilitate model creation

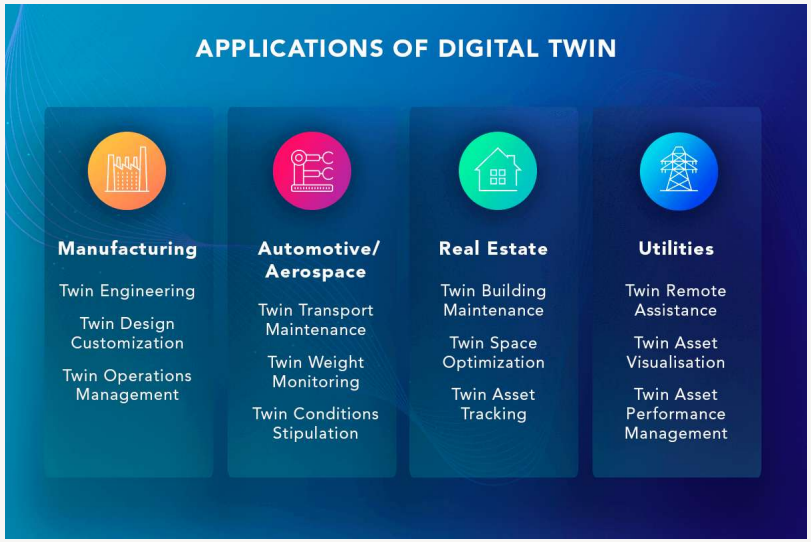
DIGITAL TWIN

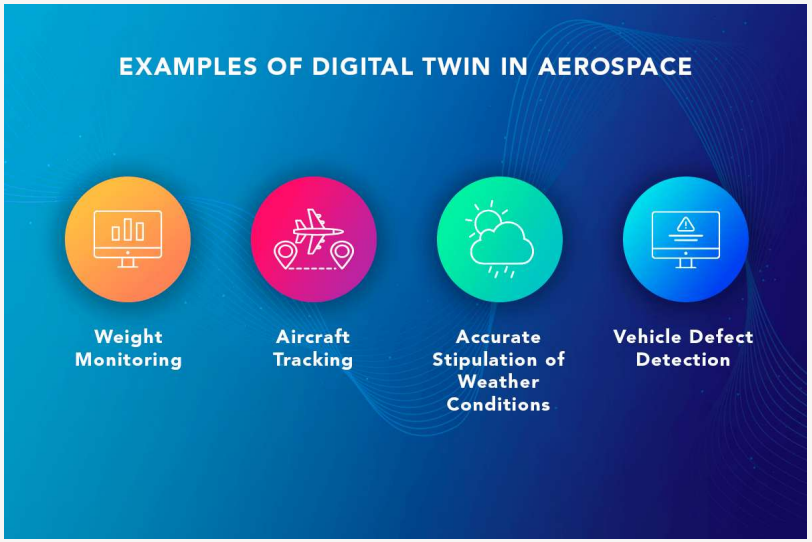
Characteristics of Digital Twins



Benefits of Digital Twin

Applications and Examples of Digital Twin





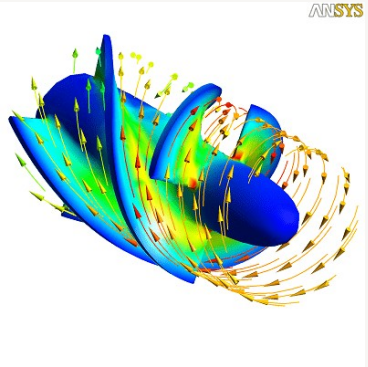
Literature

Author Name	Research Contributed
Mengnan Liu	Review of digital twin about concepts, technologies, and industrial Applications *Journal : Journal of manufacturing systems, 2020*
Louise Wright	Tell the difference between a model and a digital twin *Journal of Adv. Model. and Simul. in Eng. Sci. (2020)*
Qiuying Chen	Research Status and Trend of Digital Twin: Visual Knowledge Mapping Analysis *International Journal of Advanced Smart Convergence Vol.10 No.4 84-97 (2021)*

Literature

Review of digital twin about concepts, technologies and industrial applications

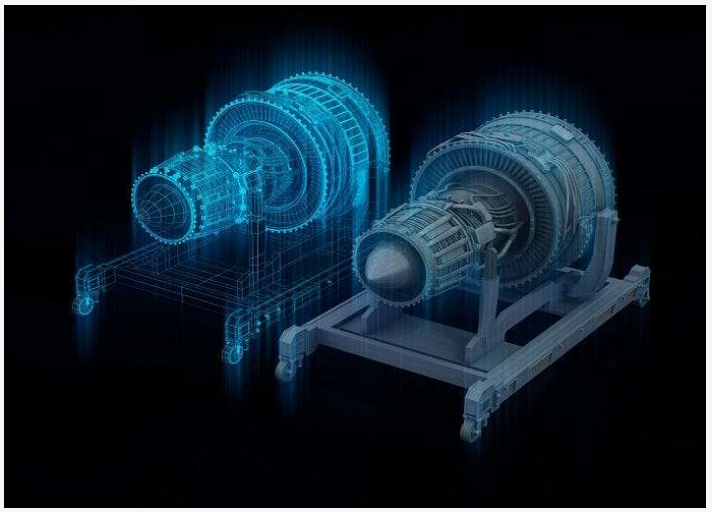
Various kinds of engineering software and digitalized equipment are widely applied through the lifecycle of massive data of different types are being produced. However, these industrial products. As a result, a are hysteretic and isolated from each other, leading to low efficiency and low utilization of these valuable data. Simulation based on theoretical and static model has been a conventional and powerful tool for the verification, validation, and optimization of a system in its early planning stage, but no attention is paid to the simulation application during system run-time. With the development of new-generation information and digitalization technologies, more data can be collected, and it is time to find a way for the deep application of all these data.



Literature

How to tell the diference between a model and a digital twin

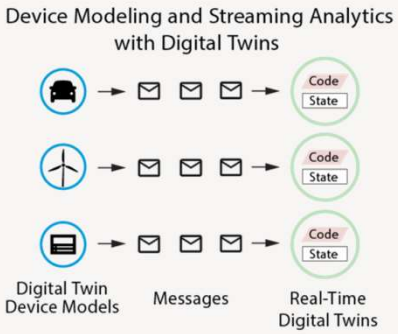
Carroll. “Digital twin” is currently a term applied in a wide variety of ways. Some diferences are variations from sector to sector, but defnitions within a sector can also vary signifcantly. Within engineering, claims are made regarding the benefts of using digital twinning for design, optimisation, process control, virtual testing, predictive maintenance, and lifetime estimation. In many of its usages, the distinction between a model and a digital twin is not made clear.



Literature

Research Status and Trend of Digital Twin: Visual Knowledge Mapping Analysis

To comprehensively analyze the development trends and research trends of digital twins, we performed statistical analysis of the relevant literature on digital twins within the core collection database of Web of Science. Through our research, we have shown that the current situation, trends, and hotspots of digital twin research were analyzed via CiteSpace. This study demonstrates that research on digital twins is rapidly growing in popularity, that the output of the research depends largely on the core group of authors conducting it, and that digital twins warrant cross-domain and cross-disciplinary research pathways.

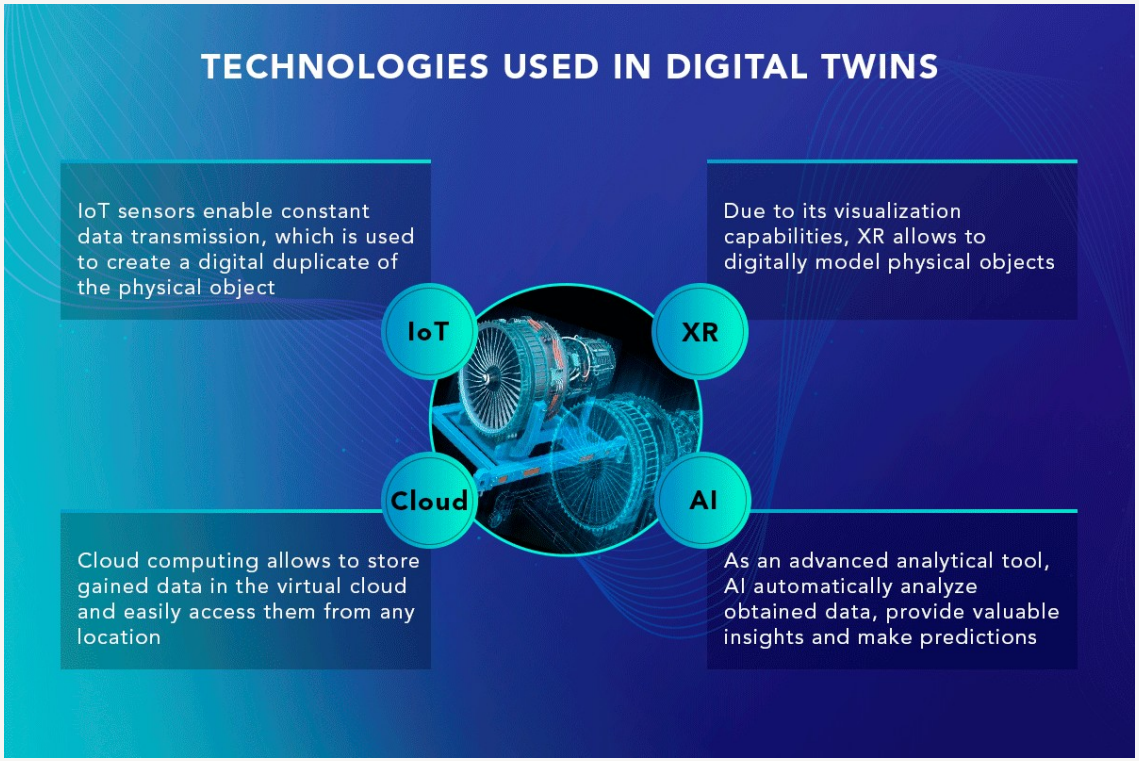


- To Create a Digital Twin Model of a screw jack
- To understand the complexities of technology to create a Digital Twin.
- To Understand Digital Twin in a much deeper Insight.

Methodology

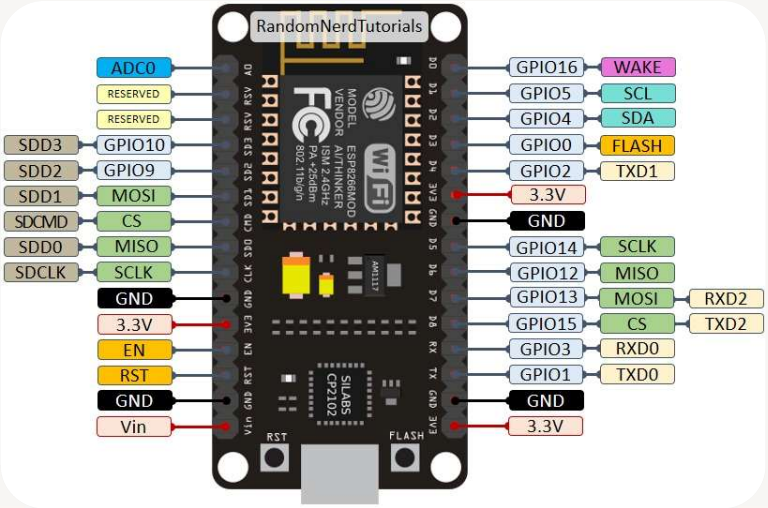
In order to Create and develop a Digital Twin Model we use Technologies like

- IoT
- Cloud Computing
- AI
- ML
- Data Analaytics



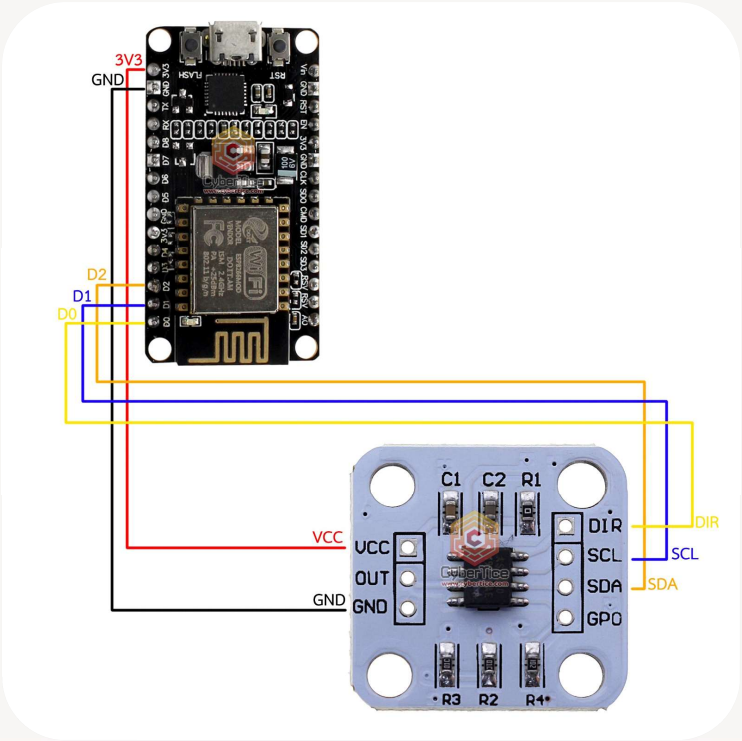
Micro controller

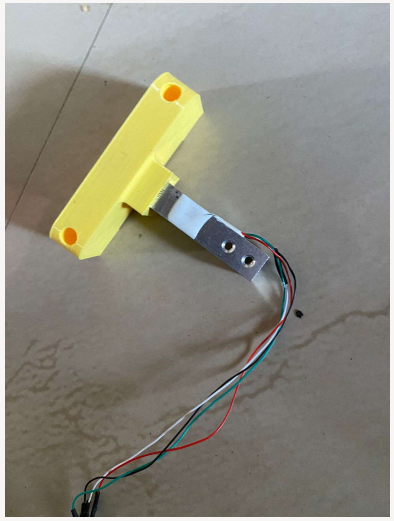
- We have collected data about the physical object or system. This includes sensor data, CAD models, manufacturing data, and operational data.
- Using the data collected, we have created a 3D model of the physical object or system. This model is accurate and represent the physical object or system as closely as possible.
- Once the 3D model is completed, we have integrated it with sensors that will monitor the physical object or system in real-time. This is typically done through IoT devices



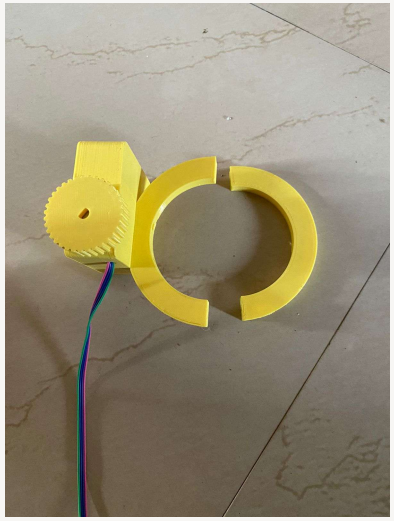
Circuit Pinout diagram

- With the sensor data coming in, we have to develop algorithms that will analyze and interpret the data, providing insights into the behavior of the physical object or system.
- With the digital twin in place, we can now simulate and optimize the behavior of the physical object or system. This can be done to test different scenarios and identify potential issues before they occur in the physical world.

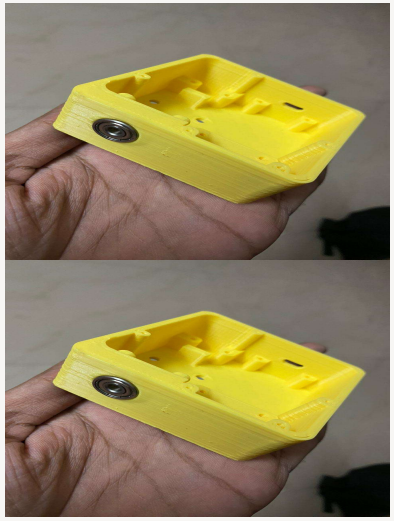




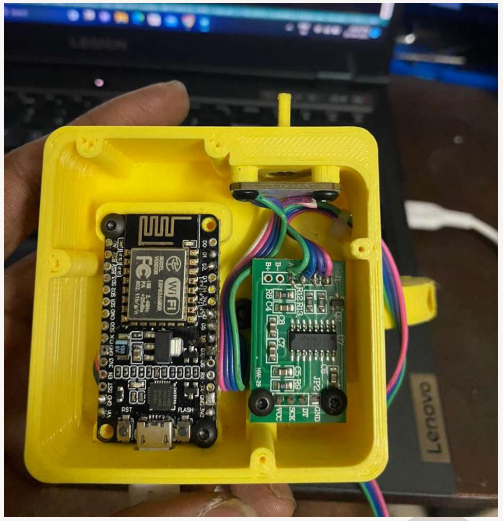
Loadcell



Gears



Box



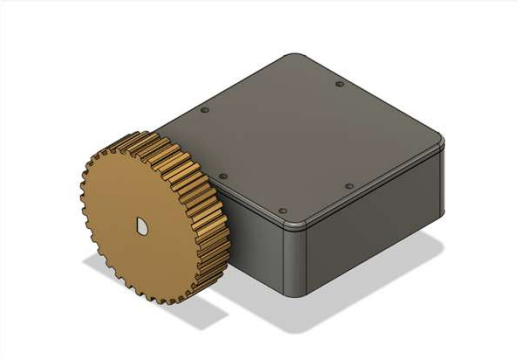
Microcontroller

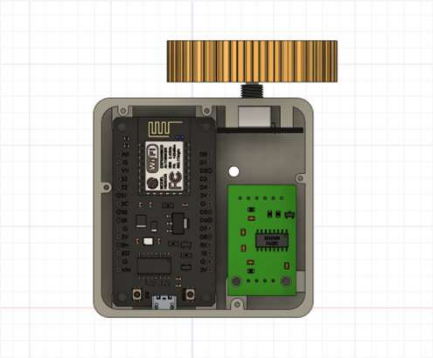
Experimental setup

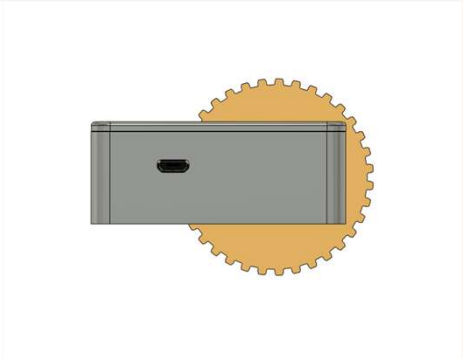
Construction

- Screw jack is taken.
- Load cell is attached to the head of the screw to read the load acting on screw jack.
- A spur gear was attached to head of screw jack.
- Another small spur gear is coupled with gear 1, which is connected to magnetic encoder.
- Micro-controller, amplifier and magnetic encoder are placed inside the sensor box attached to the body using 3d printed supports.
- The signals are transmitted through USB cable.

3D Models of Screw Jack and sensor box



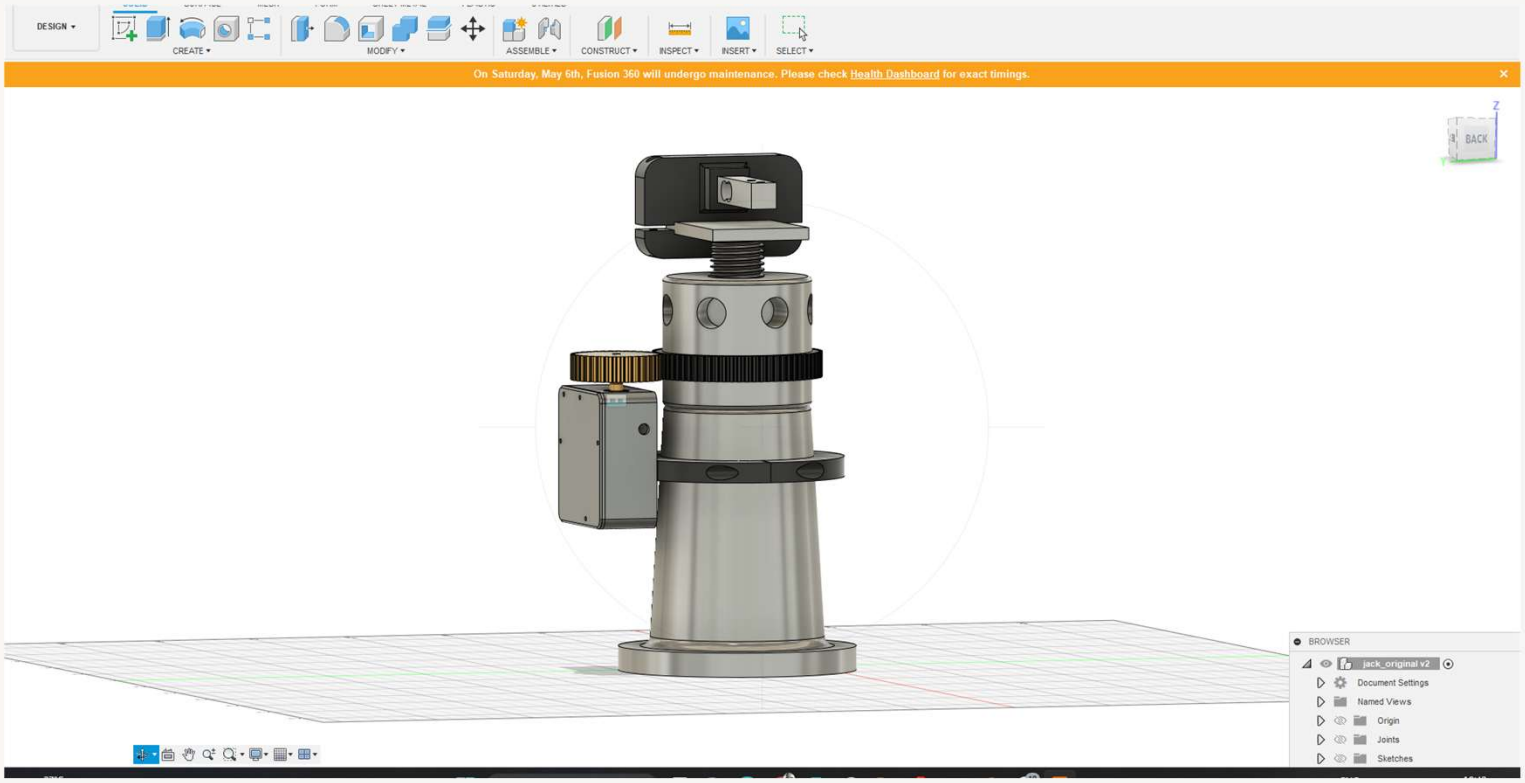




Sensor Box

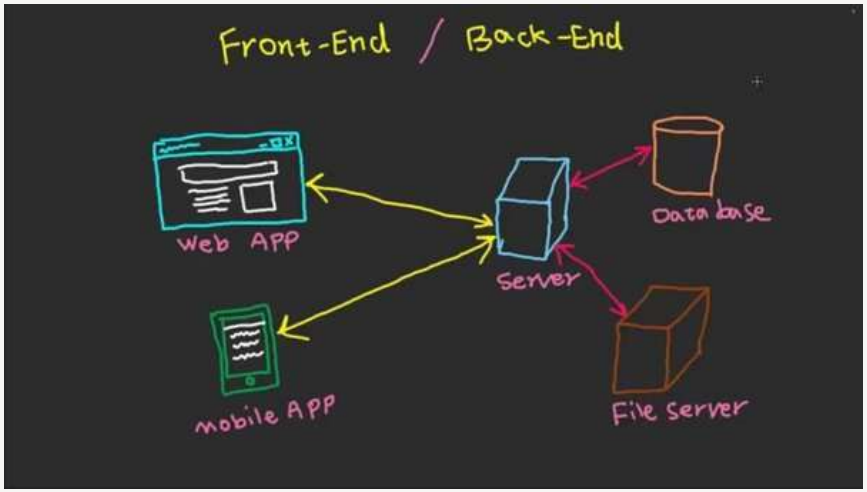
Screw Jack

3D Model of Screw Jack along with equipment



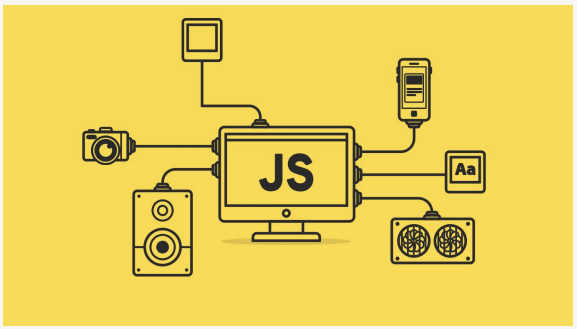
Architecture

- Backend consists of Source code that integrates 3D Model and The physical screw jack.
- Frontend consists of 3D Model that replicates the physical screw jack, simply the digital twin of screw jack.
- Frontend is also known as client and Backend is also known as Server.
- Entire backend is developed using java script

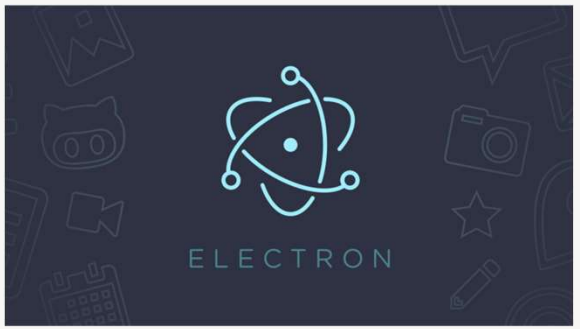


Technologies used

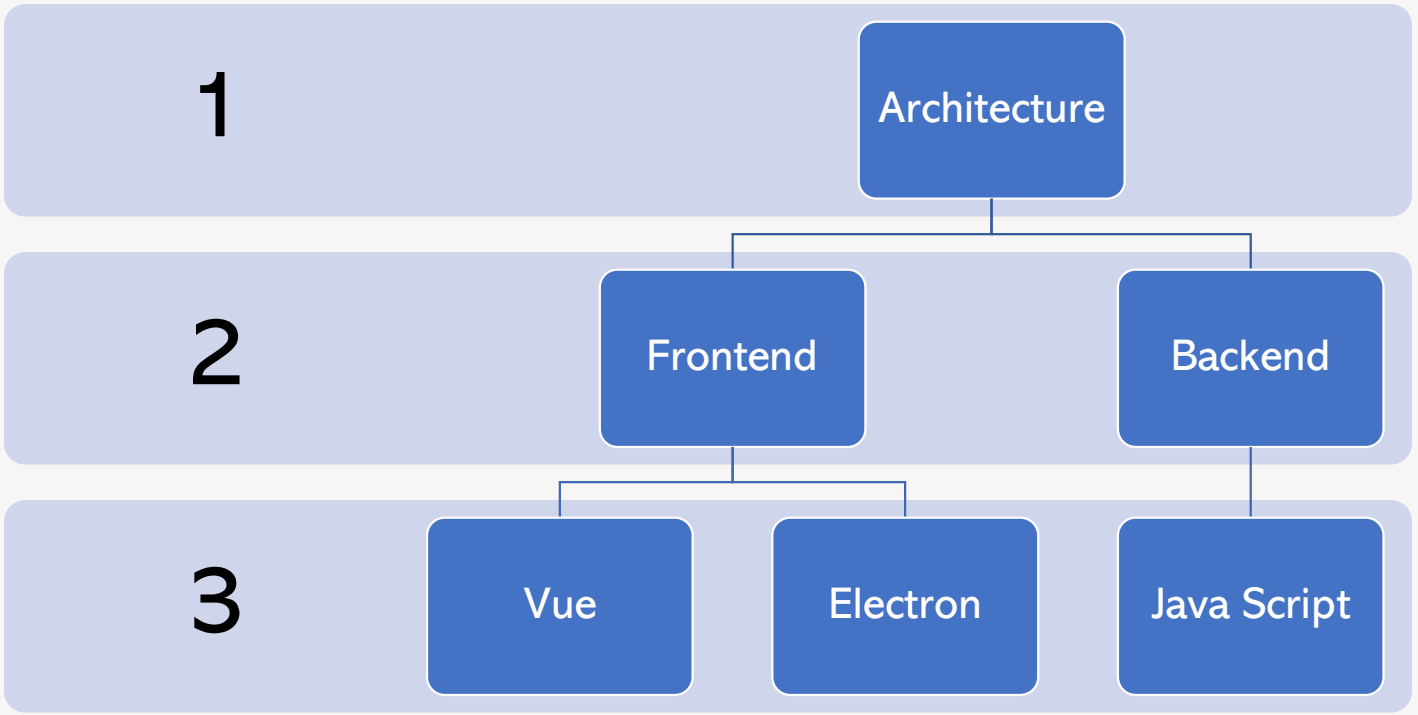
Vue Framework



Java Script



Electron Runtime Library


1
Architecture
2
Frontend
Backend
3
Vue
Electron
Java Script

Experimental Procedure

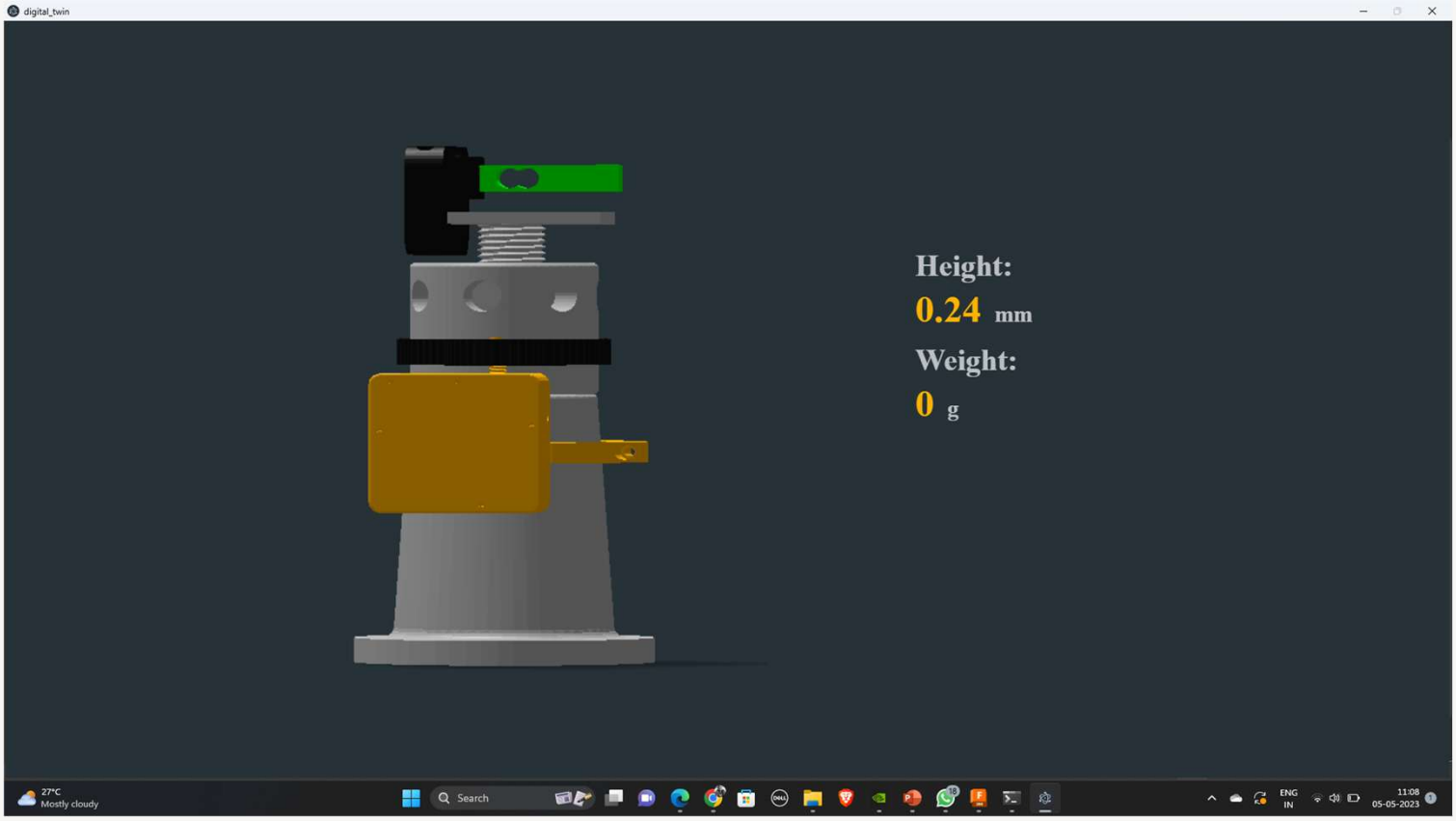
- All the source codes are saved in the PC or Laptop
- In order to execute firstly command line need to be opened.
- Two command line windows are opened, one is to run frontend and other one to run backend.
- In the backend command line, change the directory to backend using ~ cd command.

Command for backend is : node index.js

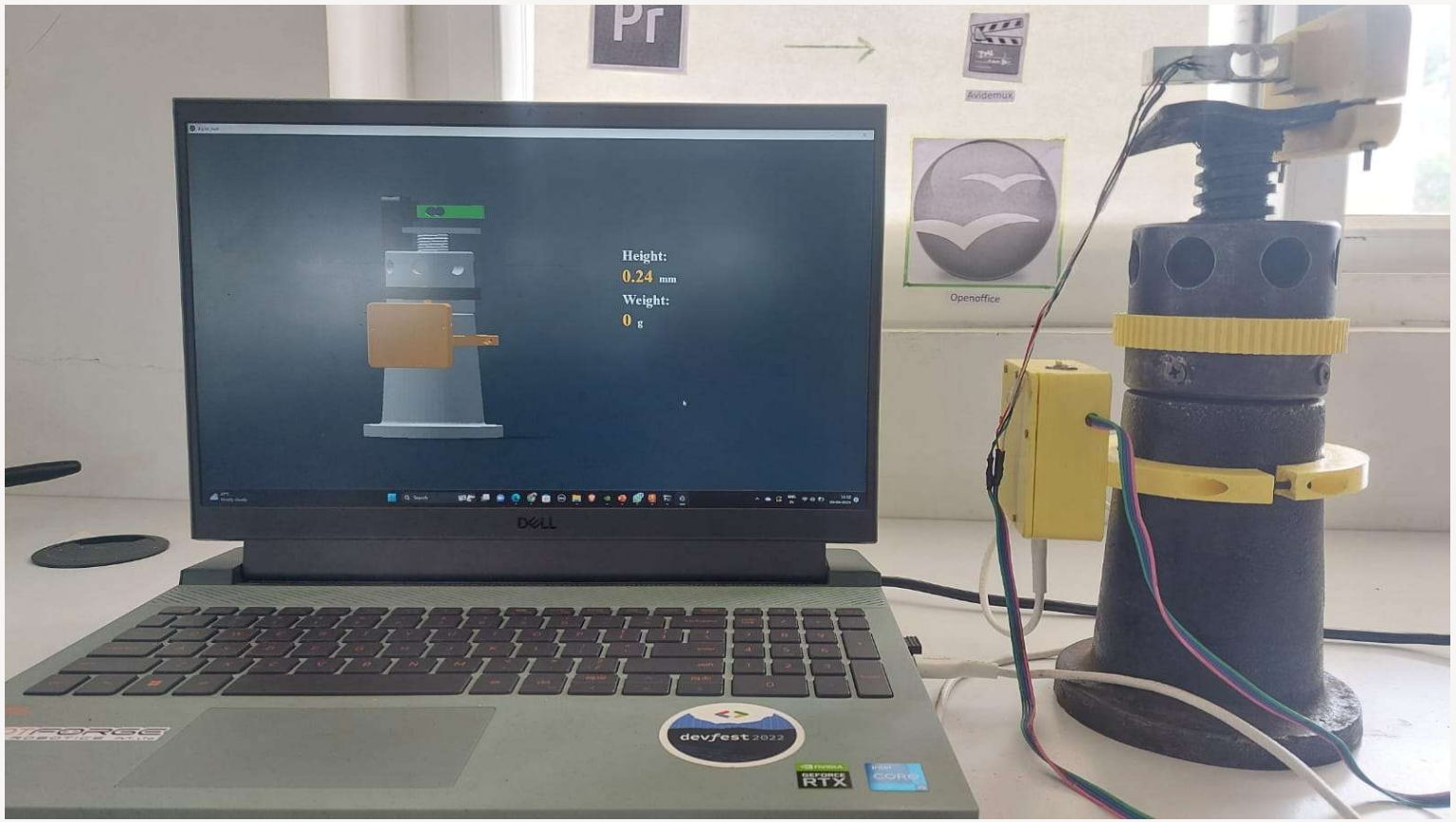
- In the frontend command line, change the directory to frontend using ~ cd command.

Command for Frontend is : npm run electron:serve

Results


digital_twin
Height:
0.24 mm
Weight:
0 g
27°C
Mostly cloudy
Search
ENG
IN
11:08
05-05-2023

Results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0.24 mm
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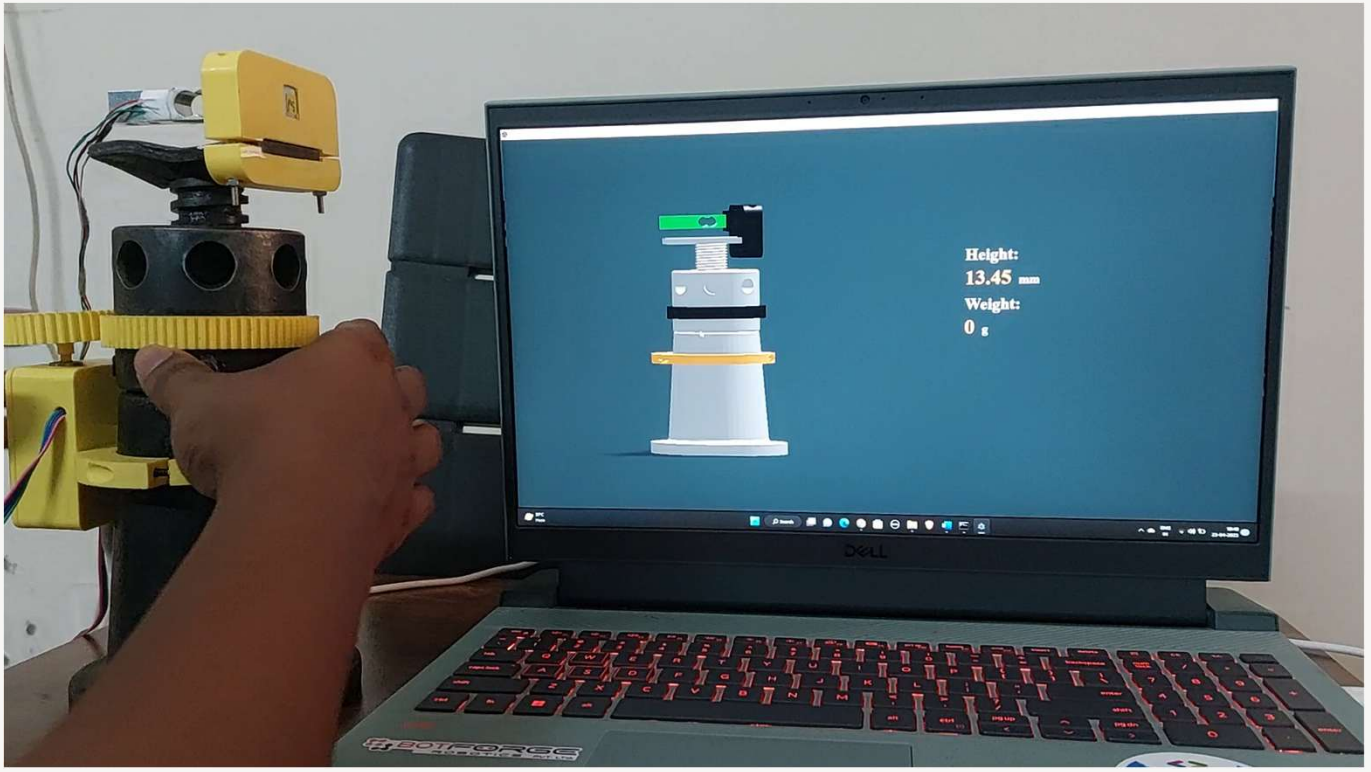
Avidemux
Openoffice
DELL
devfest 2022

Result



Conclusion

By creating a virtual replica of a physical system or component, engineers can analyze its behaviour and predict its performance under different conditions. Real-time analysis is essential in mechanical systems to ensure optimal performance and prevent failures. Digital twin technology enables engineers to monitor and analyze the behaviour of mechanical systems in real-time, allowing for early detection of potential problems. This early detection can lead to faster and more efficient maintenance, reducing downtime and improving overall system reliability. In addition, digital twin technology can be used to simulate different scenarios and test the performance of mechanical systems under various conditions. This allows engineers to optimize the design and operation of mechanical systems, leading to better performance, increased efficiency, and reduced costs. Overall, digital twin technology has significant potential in solving mechanical problems related to real-time analysis and detecting failures of mechanical components. As the technology continues to evolve and improve, it is likely to become an even more valuable tool for engineers working in the mechanical engineering field.

References

- https://amses-journal.springeropen.com/articles/10.1186/s40323-020-00147-4
- https://digitaltwin1.org/articles/1-12
- https://www.researchgate.net/publication/337019778_Digital_Twin_Enabling_Technologies_Challenges_and_Open_Research
- https://typeset.io/papers/digital-twin-enabling-technologies-challenges-and-open-2aylj47ira
- https://www.mdpi.com/journal/applsci/special_issues/Digital_Twins_Industry
- https://www.electronicwings.com/sensors-modules/mpu6050-gyroscope-accelerometer-temperature-sensor-module

“Intelligence is the ability to adapt to change.”

Thank you

Any Queries?