An Internship Report
on

"IOT APPLICATION DEVELOPMENT"

Submitted by

BHUPESH MILIND BORKAR
(2019BCS091)

in partial fulfillment for the Internship

of

Final Year B.Tech

IN
COMPUTER SCIENCE AND ENGINEERING

Under the guidance of
Prof. P. S. Nalwade

At

SHRI GURU GOBIND SINGHJI
INSTITUTE OF ENGINEERING AND TECHNOLOGY,
VISHNUPURI, NANDED
(MAHARASHTRA STATE)
PIN 431 606 INDIA

MAY-2023

Shri Guru Gobind Singhji Institute of Engineering & Technology, Vishnupuri, Nanded (M.S.), India – 431606.

Department of Computer Science and Engineering

Certificate

This is to certify that the internship work entitled “ASSOCIATE SOFTWARE DEVELOPER” is submitted by student BHUPESH MILIND BORKAR (2019BCS091) to Shri Guru Gobind Singhji Institute of Engineering & Technology, Nanded for the partial fulfillment of the award for the degree of Bachelor of Technology in Computer Science and Engineering. This project is a record of bonafide work carried out by him under my guidance. The content presented in this report has not been submitted to any other University or Institute for the purpose of obtaining any other degree or diploma.

Guide :

Prof. P. S. Nalwade

Head of Department :

Prof. Dr. J. M. Waghmare

ABSTRACT

This report describes my internship at Ithena Technologies Pvt. Ltd. In this internship I have been assigned the role of associate software developer in the IOT team. I have been trained and appointed as ThingWorx developer. I have been implementing my skills and knowledge in building, developing and maintaining different training as well as real time projects of the company. ThingWorx is an emerging IoT platform that is designed to accelerate digital transformation in manufacturing and offer solutions with cost-effective, reduced risk and reduced development time. The platform offers extensive capabilities for IoT application development, data management, analytics, and integration with other enterprise systems. ThingWorx assists in facilitating the transmission of data among devices, as well as tracking and monitoring devices and other objects. IoT technology empowers objects to become 'smart' by enabling data transmission and automating tasks, eliminating the need for physical intervention. During my internship as a ThingWorx developer, our primary responsibilities revolved around developing dashboards and monitoring platforms for a diverse range of client companies, including those involved in high-end machinery, injection molding systems, centrifugal machines, and barges. To accomplish these tasks, we utilized various

technologies, languages, and frameworks such as Java, JavaScript, HTML, CSS, Postman API services, analytical tools, and database tools.

ACKNOWLEDGMENT

I am extremely grateful to **Mrs. Jaishri Waghmare**, Head of Department, Department of Computer Science and Engineering, Shri Guru Gobind Singhji Institute of Engineering and Technology, Nanded for providing all the required resources for the successful ongoing of my internship .

My heartfelt gratitude to my internal guide **Mr. P. S. Nalwade**, Project Guide, TPO head **Dr. Ravindra Joshi** for his valuable suggestions and guidance in the preparation of the report.

I would like to express my deepest gratitude and appreciation to my mentor, **Miss Kajal Hulage**, and my project manager, **Mr. Shriniwas Waphare**, for their invaluable support and guidance throughout my internship. Their mentorship has been instrumental in shaping my professional growth and enhancing my skills.

I express my thanks to class coordinator **Mrs. Suvarna Bansode** , Senior lecturer and all staff members and friends for all the help and coordination extended in bringing out this internship opportunity.

Last but not the least ; I am very much thankful to my parents who guided me in every step which I took.

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COMPANY OVERVIEW

Ithena Technologies Pvt Ltd is Startup from Pune founded in 2019 by Tushar Diwakar Laghate and Probodh Chiplunkar with its offices in Richmond, United States and Pune, Maharashtra.

ITHENA is a new-age solutions company focused on integrating digital technology with business processes - to help its customers become smarter and run safer.
Its mission is to help customers monetize their digital investments. Utilizing both, proven enterprise software as well as next-generation digital technology, ITHENA brings a persona-based experience to various functions of the enterprise and the industry ecosystem.

Its technology focus includes experience across Industrial IoT, AI/ML, Modern Experience, Data & Analytics, Automation, and BlockChain. ITHENA provides services & solutions that help Smart Cities, Manufacturing, Life Sciences & Services, Logistics & Distribution companies worldwide.

I am currently a part of the IoT department, where I work as an intern specializing in ThingWorx development. This opportunity has provided me with invaluable exposure to the latest technologies and has significantly contributed to my professional growth and development.

Internship Timeline :

The internship timeline consists of 6 months starting from 2nd January, 2023 to 30th June, 2023.

Currently, I am employed in the IoT sector as a ThingWorx developer, focusing on developing IoT applications and solutions. My primary domain of expertise lies in IoT, where I leverage the capabilities of ThingWorx to create innovative and efficient solutions for various industries and sectors.

Stage 1 : Thingworx Core Programming Fundamentals (4 weeks)

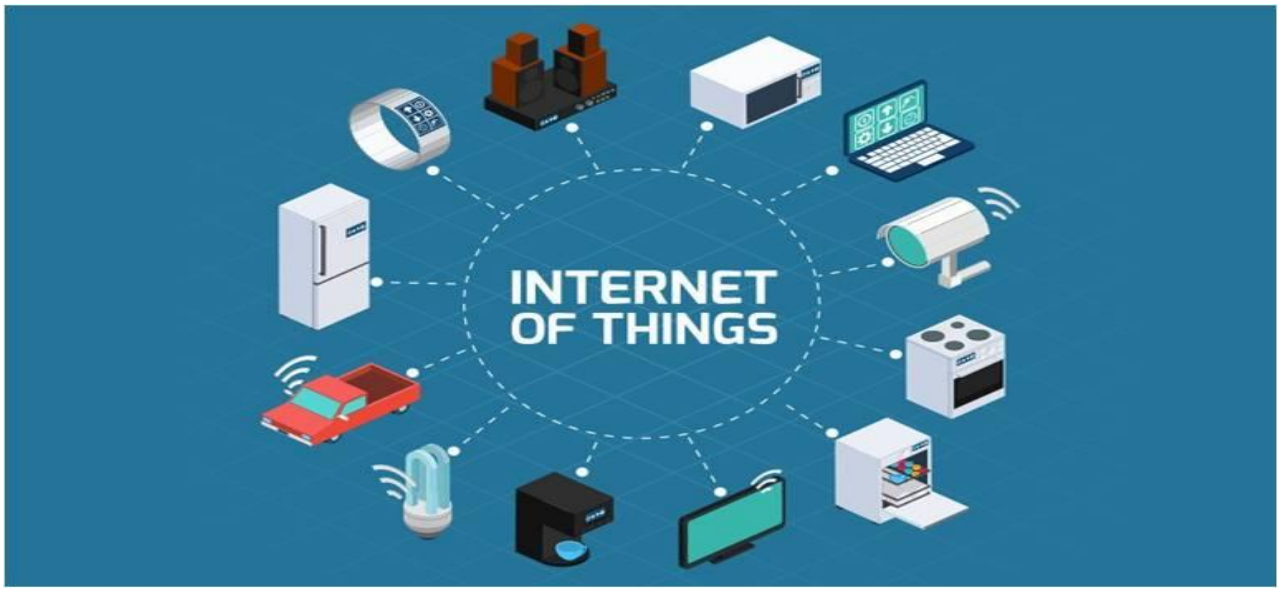
Stage 2 : Thingworx end-to-end IoT application projects. (4 weeks)

Technologies :

1. Thingworx
2. JavaScript
3. HTML
4. CSS
5. JAVA
6. SQL

CHAPTER 2.

INTRODUCTION



1.1 INTRODUCTION TO IOT

The **Internet of Things** is the idea of everyday objects like light bulbs and thermostats being connected to the Internet, enabling us to communicate with devices and allowing devices to "talk" to each other.

By some projections, there are expected to be an upward of 500 billion devices connected to the Internet by 2030, turning "dumb" devices into intelligent ones capable of collecting, processing and disseminating data. For instance, imagine putting your prescriptions in bottles outfitted with caps that remind you to take your pills and even coordinate refills with your physician.

1.2 Importance of IoT

Over the past few years, IoT has become one of the most important technologies of the 21st century. Now that we can connect everyday objects — kitchen appliances, cars, thermostats, baby monitors — to the internet via embedded devices, seamless communication is possible between people, processes, and things.

By means of low-cost computing, the cloud, big data, analytics, and mobile technologies, physical things can share and collect data with minimal human intervention. In this hyperconnected world, digital systems can record, monitor, and adjust each interaction between connected things. The physical world meets the digital world—and they cooperate.

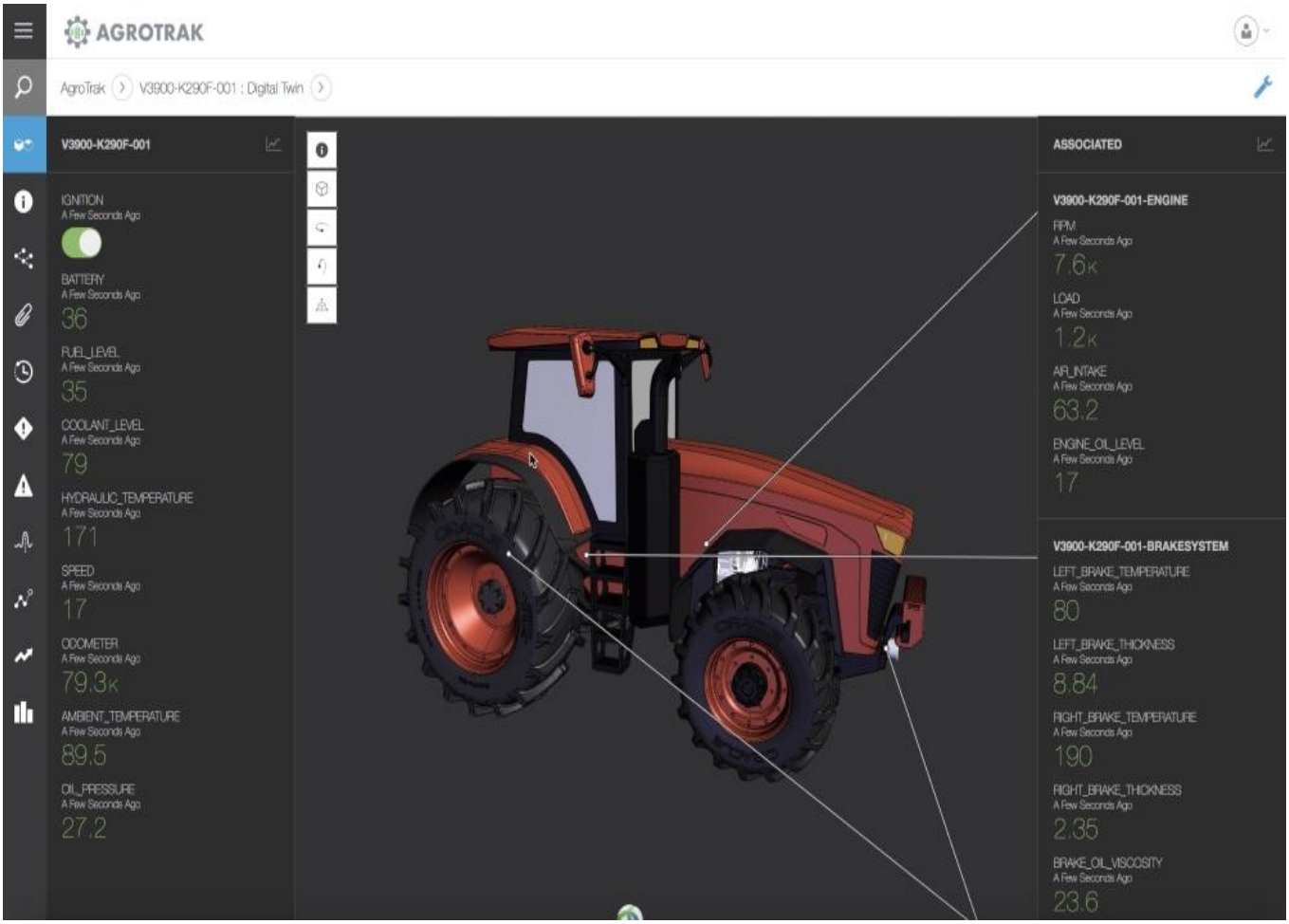


Fig No. 2.1 Interface of IoT Platform.

1.3 Industrial IoT

Industrial IoT (IIoT) refers to the application of IoT technology in industrial settings, especially with respect to instrumentation and control of sensors and devices that engage cloud technologies. Recently, industries have used machine-to-machine communication (M2M) to achieve wireless automation and control. But with the emergence of cloud and allied technologies (such as analytics and machine learning), industries can achieve a new automation layer and with it create new revenue and business models. IIoT is sometimes called the fourth wave of the industrial revolution, or Industry 4.0.

The following are some common uses for IIoT :

- Smart manufacturing
- Connected assets and preventive and predictive maintenance
- Smart power grids
- Smart cities
- Connected logistics
- Smart digital supply chains

1.4 IoT applications

1.4.1 Business-ready, SaaS IoT Applications

IoT Intelligent Applications are prebuilt software-as-a-service (SaaS) applications that can analyze and present captured IoT sensor data to business users via dashboards. We have a full set of IoT Intelligent Applications.
IoT applications use machine learning algorithms to analyze massive amounts of connected sensor data in the cloud. Using real-time IoT dashboards and alerts, you gain visibility into key performance indicators, statistics for mean time between failures, and other information. Machine learning–based algorithms can identify equipment anomalies and send alerts to users and even trigger automated fixes or proactive counter measures.

With cloud-based IoT applications, business users can quickly enhance existing processes for supply chains, customer service, human resources, and financial services. There's no need to recreate entire business processes.

1.5 Ways IoT applications are deployed :

The ability of IoT to provide sensor information as well as enable device-to-device communication is driving a broad set of applications. The following are some of the most popular applications and what they do.

1.5.1 Create new efficiencies in manufacturing through machine monitoring and product-quality monitoring.

Machines can be continuously monitored and analyzed to make sure they are performing within required tolerances. Products can also be monitored in real time to identify and address quality defects.

1.5.2 Improve the tracking and "ring-fencing" of physical assets.

Tracking enables businesses to quickly determine asset location. Ring-fencing allows them to make sure that high-value assets are protected from theft and removal.

1.5.3 Use wearables to monitor human health analytics and environmental conditions.

IoT wearables enable people to better understand their own health and allow physicians to remotely monitor patients. This technology also enables companies to track the health and safety of their employees, which is especially useful for workers employed in hazardous conditions.

1.5.4 Drive efficiencies and new possibilities in existing processes.

One example of this is the use of IoT to increase efficiency and safety in connected logistics for fleet management. Companies can use IoT fleet monitoring to direct trucks, in real time, to improve efficiency.

1.5.5 Enable business process changes.

An example of this is the use of IoT devices for connected assets to monitor the health of remote machines and trigger service calls for preventive maintenance. The ability to remotely monitor machines is also enabling new product-as-a-service business models, where customers no longer need to buy a product but instead pay for its usage.

In the Internet of Things, all the things can be put into three categories:

- Sensors that collect information and then send it.
- Computers that receive information and then act on it.
- Things that do both.

1.6 Collecting and Sending Information

This means sensors. Sensors can measure temperature, motion, moisture, air quality, light, and almost anything else you can think of. Sensors, when paired with an internet connection, allow us to collect information from the environment which, in turn, helps make better decisions.

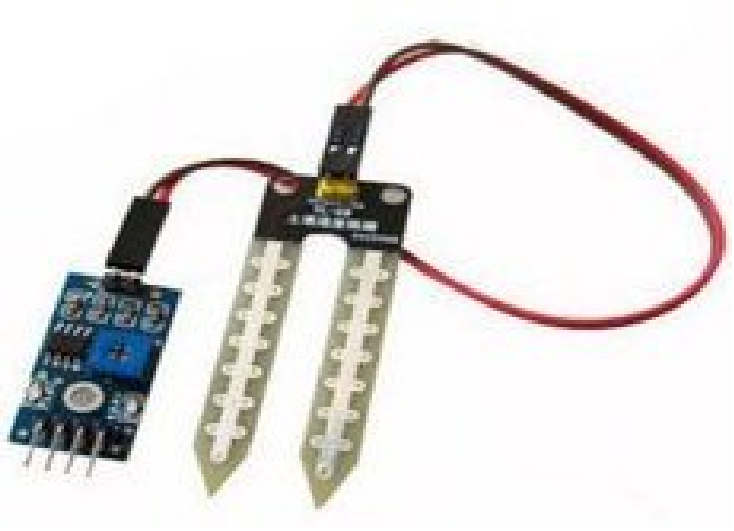


Fig. 2.2 : Soil moisture sensor

On a farm, automatically getting information about soil moisture can tell farmers exactly when crops need to be watered. Instead of watering too much or too little (either of which can lead to bad outcomes), the farmer can ensure that crops get exactly the right amount of water.

CHAPTER 3

TOOLS AND PLATFORM FOR IOT DEVELOPMENT

Top IoT Tools and Platforms for IoT Development

Internet of Things (IoT) is the new buzzword in the technology sector that is doing the rounds in the internet-driven space. It's one of the fastest-growing industries. IoT is an emerging technology that connects billions of smart devices and sensors to the internet in an efficient, secure, and convenient way.

Many IoT developers are ruling the industry by trying their hands with IoT devices and applications for various organizations. The One Technologies is an offshore IoT application development company that provides end-to-end Internet of Things app development services at affordable prices.

Here are the top IoT tools and platforms for IoT developers and development.

1. **Eclipse IoT**

Eclipse IoT is an open-source platform that allows IoT developers and IoT development companies to develop applications in Java. With the help of Eclipse IoT, you can build IoT Devices, Cloud Platforms, and Gateways. This tool focuses on the development, adoption, and promotion of open-source IoT technologies.
These IoT protocols, application frameworks and services, and tools are promoted as the best-suited programming language for IoT using Lua programming language.

2. Node-RED

Node-RED is a simple and open-source visualization tool built on Node.JS which is used to connect the devices, services, and APIs together for the Internet of Things. Node-RED is a user-friendly interface, developed by IBM's Emerging Technology department, allowing you to connect hardware, an API or an online service with tight integration. It helps you connect the devices easily and quickly, helps deal with the flow of the data, and integrates with APIs.

3. Tessel 2

Tessel 2 is a robust IoT platform that is used to build basic IoT solutions and prototypes. It integrates additional sensors and modules. This board has the capacity to hold up to a dozen modules including RFID, GPS, camera, and accelerometer.

This Tessel is very easy for those developers who are familiar with Node.JS programming. This way, Tessel can be used to host several servers and hardware firmware IoT solutions. You can leverage all the libraries of Node.JS to unveil a host of devices in minutes with Tessel.

4. Arduino

Arduino is an open-source prototyping platform offering both IoT hardware and software. Arduino is a hardware specification that can be applied to interactive electronics and a set of software which includes the Integrate Development Environment (IDE) and the Arduino programming language. It's one of the most preferable IDEs in all IoT development tools which is easy and simple to use.
Arduino can be your first choice if you are planning to build a computer that can sense and control more of the physical world when compared to your normal stand-alone computing device.

5. Kinoma Create

Kinoma Create is a device that allows establishing a connection between two devices without having too high programming knowledge in JavaScript. Kinoma Create consists of many features that are required for developing small IoT applications like connecting light, temperature or movement sensors for a specific purpose with mobile notifications in case of any alterations.
Kinoma Create has some fundamental components which are as follows:

- Touch screen
- ARM SoC 800 MHz processor
- Bluetooth and integrated WiFi
- Several ports to connect peripherals, including a USB 2.0 port
- Memory of 128 MB and flash memory of 16 MB
- MicroSD card slot
- Speaker and microphone features
- Linux distribution

6. Device Hive

Based on Data Art's AllJyone, Device Hive is a free open-source Machine to Machine (M2M) communication framework. Launched in 2012, it's considered one of the most preferred platforms for IoT app development. Since Device Hive is a cloud-based API, you can control it remotely without having network configuration. A similar thing applies to the libraries, portals, and management protocols.

7. Home Assistant

Home Assistant is an open-source tool that is used for home automation and functions with a Python-based coding system. Mobile or desktop browsers can easily have their control over the IoT system developed with this tool. It's very easy to set up and is trusted for operations, security, and privacy. The software supports any systems which are running on Python 3.

IoT Hardware Platforms

1. Particle.io

Particle.io is an end-to-end IoT platform that provides IoT hardware development platform, connectivity, device cloud, and apps. To build and manage your IoT fleet, it comes up with robust, reliable infrastructure features. Cellular (2G/3G/LTE), Wi-Fi, or Mesh are provided for connectivity. It also provides Device Cloud, IoT Rules Engineer, Device OS, and developers tools as IoT software.

2. ThingWorx

ThingWorx is an emerging IoT platform that is designed to accelerate digital transformation in manufacturing and offer solutions with cost-effective, reduced risk and reduced development time. It provides flexibility to access data and IoT from on-premise, off-premise or cloud, and hybrid environments.

It gives flexibility and scalability for future developments and upgrades, helping to manage the development lifecycle for IoT applications.

3. IBM Watson IoT

Cloud-based Watson by IBM is one of the leaders in the IoT development system which collects data from devices, equipment, and machines and processes it in real-time to derive value and better business decisions. IBM claims to have developed a strong analytical solution for cognitive analytics in IoT.

The platform provides add-ons services such as analytics, artificial intelligence, and blockchain services.

4. Samsung Artik

Samsung has launched its IoT development platform solution named Artik Cloud. It provides a wide range of modules to rapidly connect devices to the cloud and start gathering data. Artik Cloud has a set of connectors that can be used to connect to third-party services. With this platform, we can store data from connected devices and aggregate this information.

Artik Cloud simplifies the development process by providing an SDK and a set of APIs that are ready to use. One of the top features of Artik modules is a miniaturized solution for multiple applications.

Fig 3.1 Analysis Window

CHAPTER 4

THINGWORX PROJECT 1 – CAR DASHBOARD

4.1 Thingworx

Thingworx is a platform for the rapid development and deployment of smart, connected devices. Its set of integrated IoT development tools support connectivity, analysis, production, and other aspects of IoT development.

It offers Vuforia for implementing augmented reality development, and Kepware for industrial connectivity. KEPServerEX provides a single point for data distribution, and facilitates interoperability when partnered with a ThingWorx agent.

Components

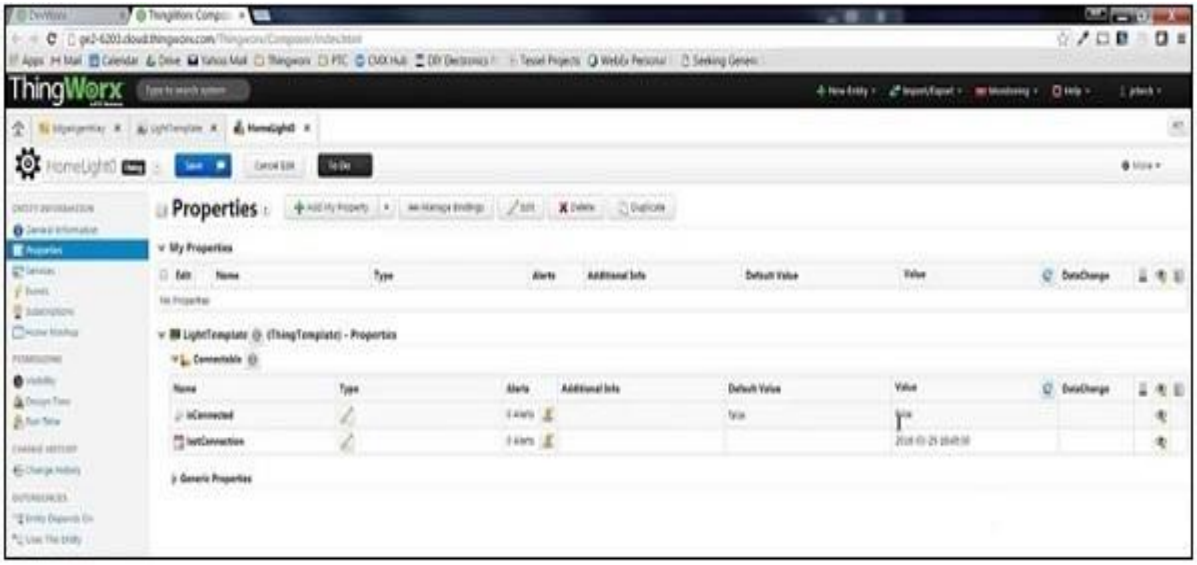
Thingworx offers several key tools for building applications. These tools include the Composer, the Mashup Builder, storage, a search engine, collaboration, and connectivity. The Composer provides a modeling environment for design testing. The Mashup Builder delivers easy dashboard building through common components (or widgets); for example, buttons, lists, wikis, gauges, and etc.

Thingworx uses a search engine known as SQUEAL, meaning Search, Query, and Analysis. Users employ SQUEAL in analyzing and filtering data, and searching records.

Interface

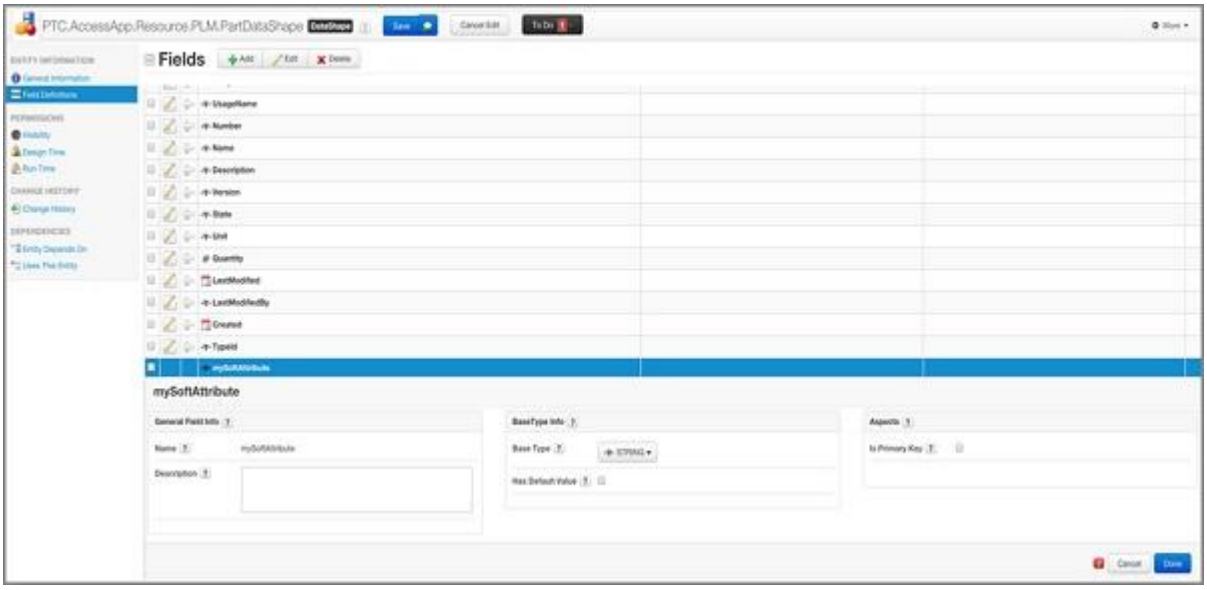
The ThingWorx platform uses certain terms we must familiarize ourselves with. In the main screen's top menu, you search for **entities** or create them. “Entity” refers to something created in ThingWorx. We can also import/export files and perform various operations on them.

In the left menu, we find entity groups, which are used to produce models and visualize data; and manage storage, collaboration, security, and the system.



When we select the Modeling category in the menu, we begin the process by creating an entity. The entity can be any physical device or software element, and it produces an event on changes to its property values; for example, a sensor detects a temperature change. We can set **events** to trigger actions through a subscription which makes decisions based on device changes.

Data Shapes consist of one or more fields. They describe the data structure of custom events, infotables, streams, and datatables. Data shapes are considered entities.



Thing Templates and **Thing Shapes** allow developers to avoid repeating device property definitions in large IoT systems. Developers create Thing Templates to allow new devices to inherit properties. It use Thing Shapes to define Templates, properties, or execute services.

Note a Thing only inherits properties, services, events, and other qualities from a single template, however, Things and templates can inherit properties from multiple Thing Shapes.

4.2 Software Development Life Cycle

Here's a step-by-step flow and development process for an IoT application using ThingWorx, including the specific entities and tools involved:

1. Requirement Analysis:

- Identify the requirements of the IoT application, such as the type of machines and sensors to be connected, data analytics needs, and desired use cases.

2. Sensor Integration:

- Select appropriate sensors and devices for collecting data from the machines.

- Use Kepware, an industrial connectivity platform, to establish communication between the sensors/devices and ThingWorx.

3. ThingWorx Platform Setup:

- Set up the ThingWorx platform, either on-premises or using ThingWorx Foundation (cloud-based).

- Configure Thing Templates, Thing Shapes, and Thing Properties in ThingWorx to represent the connected machines/devices

4. Data Ingestion and Storage

- Use Kepware to connect the sensors/devices to ThingWorx and enable data ingestion.

- Configure ThingWorx Data Subscriptions to receive and store the sensor data in the ThingWorx Data Store.

5. Data Processing and Analytics:

- Utilize ThingWorx Analytics or ThingWorx Analytics Builder for data processing and analysis.

- Create data models, define rules, and set up analytics algorithms within ThingWorx Analytics to derive insights from the sensor data.

6. Application Development:

- Use ThingWorx Composer, the visual development environment, to design and develop the user interface (UI) for the IoT application.

- Create Mashups in ThingWorx Composer, combining UI elements such as charts, gauges, and tables, to provide meaningful views for end-users.

- Configure services and events within ThingWorx to enable interactivity and real-time updates on the UI.

- Implement user authentication and access controls using ThingWorx Security to ensure secure access to the application.

7. Integration and External Connectivity:

- Integrate ThingWorx with external systems or applications, such as ERP systems, CRM systems, or third-party analytics tools, using ThingWorx Integration Hub or custom integrations.

- Leverage ThingWorx Edge MicroServer or Edge SDKs to connect and manage edge devices or gateways that interact with the IoT platform.

8. Testing and Deployment:

- Conduct thorough testing of the IoT application, including functional, reliability, and performance testing.

- Utilize ThingWorx Test Bench or external testing frameworks to simulate different scenarios and validate the application's behavior.

- Once tested, deploy the application to the desired environment, such as an on-premises server or cloud infrastructure.

9. Monitoring and Maintenance:

- Set up monitoring mechanisms within ThingWorx to track the health, performance, and availability of the IoT application and connected devices.

- Implement proactive maintenance practices by monitoring sensor data, detecting anomalies, and triggering alerts or automated actions for preventive maintenance.

10. Continuous Improvement:

- Gather feedback from users and stakeholders to identify areas of improvement and potential new features.

- Utilize the extensibility of ThingWorx to incorporate enhancements, such as integrating additional sensors, adding advanced analytics capabilities, or expanding the application's scope.

Please note that Kepware is a widely used industrial connectivity platform that can facilitate communication between sensors/devices and ThingWorx.

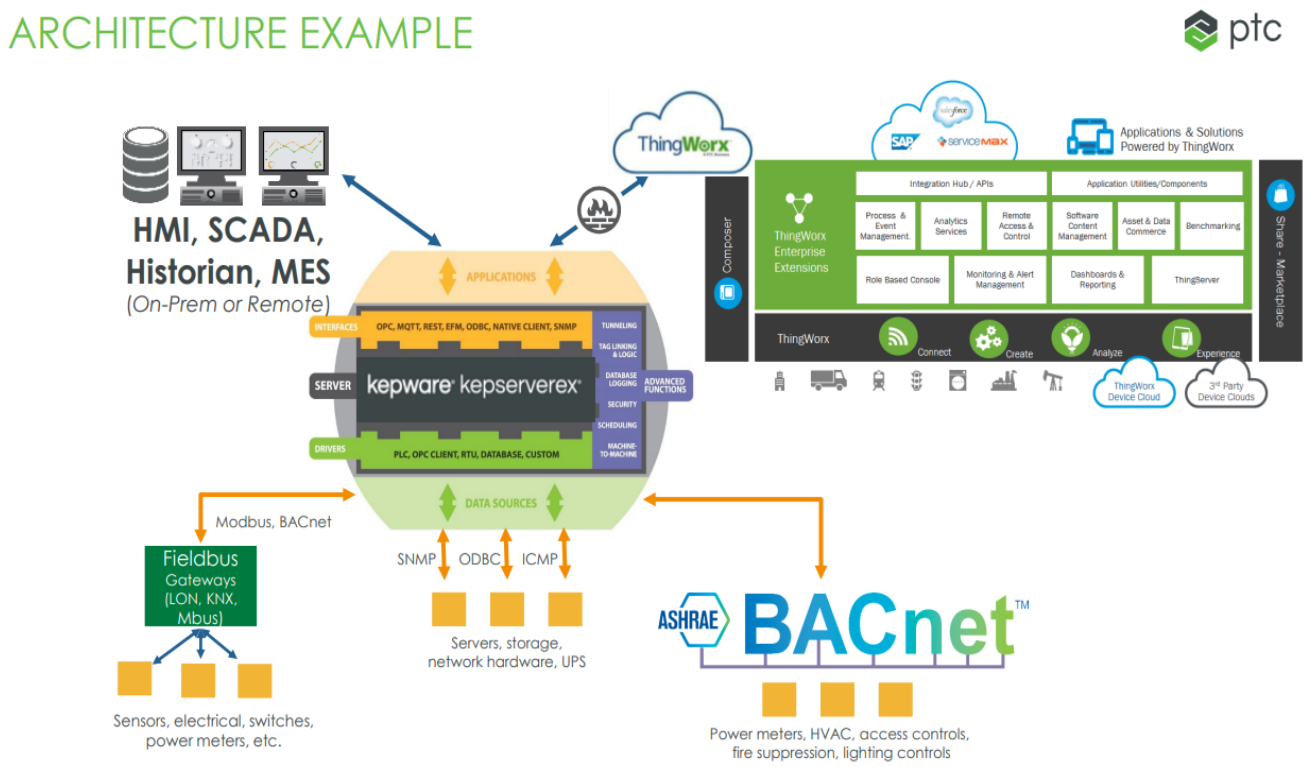


Fig.4.1 IoT Thingworx Architecture.

PROJECT 1 - CAR DASHBOARD

Car dashboard is an smart connected automated IoT project built on Thingworx where users can monitor their vehicle performance, see real time data and analyze it on a webpage. The Car Dashboard project is a comprehensive system that incorporates various essential components to provide real-time data visualization and analysis. The dashboard includes an RPM gauge, speedometer, fuel level indicator, voltage and temperature monitoring, allowing users to monitor the car's performance and vital parameters. With the ability to analyze data against different time stamps, users can gain valuable insights into the vehicle's behavior and diagnose any issues effectively. Additionally, the project incorporates functionalities such as an odometer for mileage tracking, GPS for location monitoring, and start-stop functionality for engine control. By combining these features, the Car Dashboard project offers a professional solution for monitoring and optimizing the performance of a vehicle, enhancing the overall driving experience and promoting efficient maintenance practices.

Project link :
https://iscpa.ithena.io/Thingworx/Runtime/index.html?mashup=ITH.Bhupesh.CarDB(2).Mashup

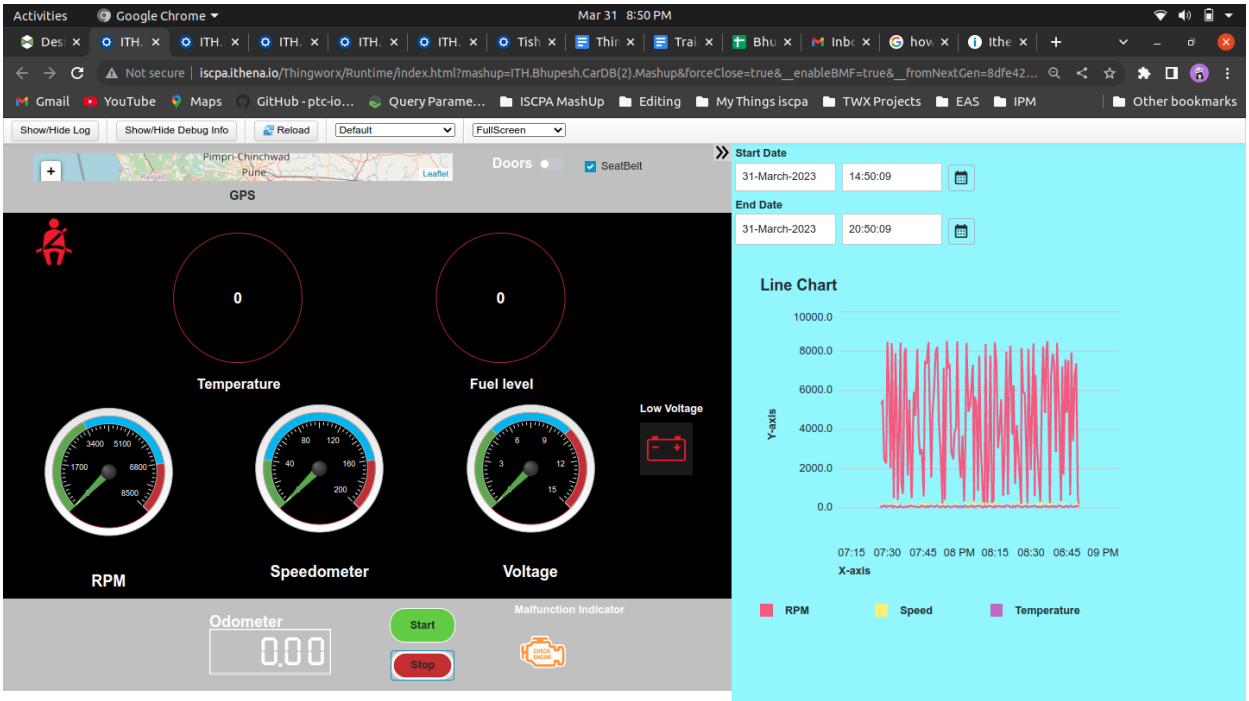
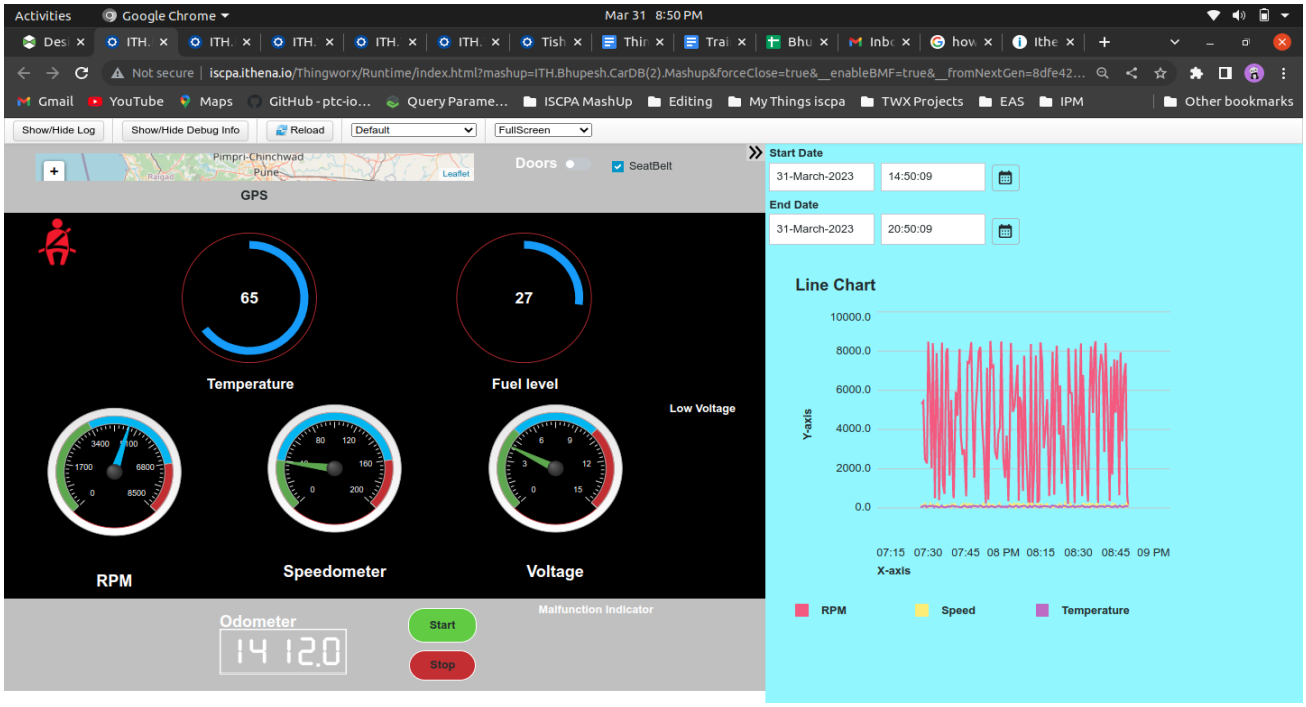
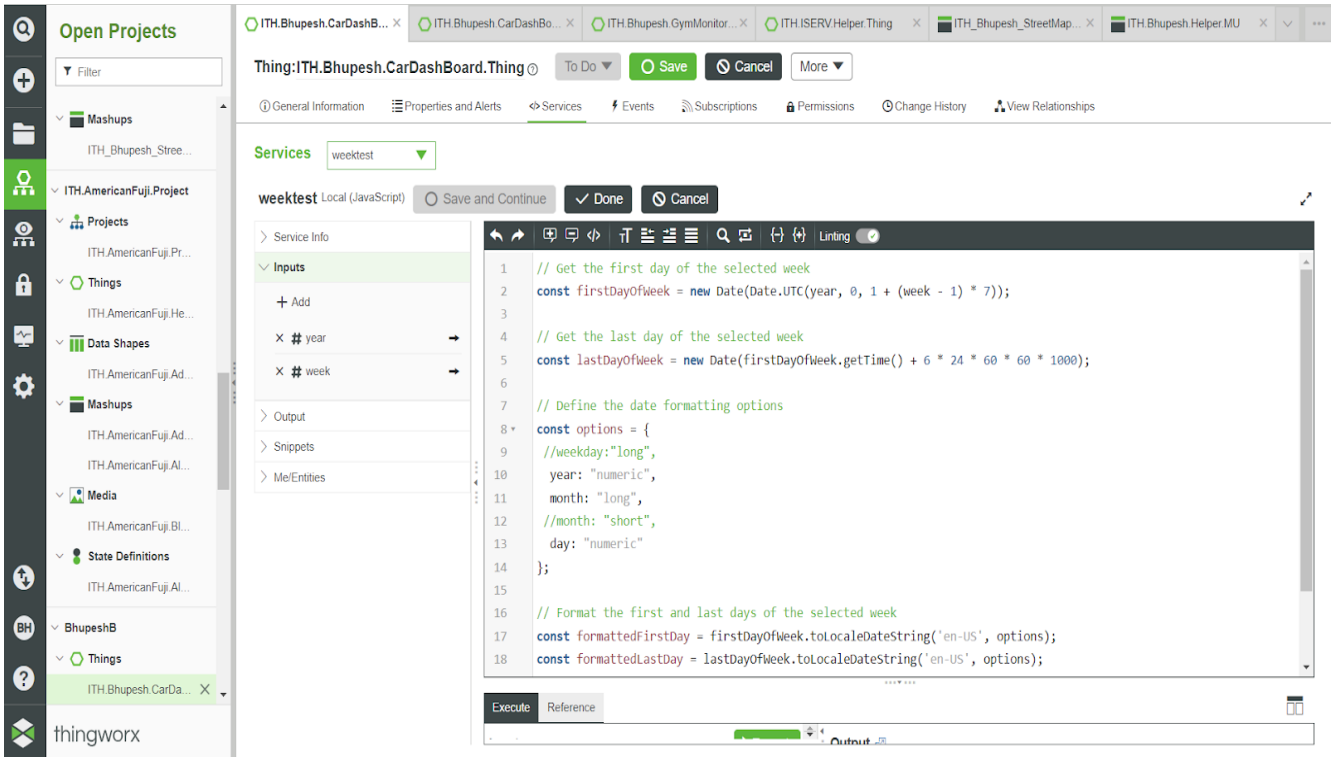


Fig 4.2 Car Dashboard.



Programming Interface Thingworx



CHAPTER 5

THINGWORX PROJECT 2 – BOILER DASHBOARD.

1. Introduction:
    - The project aims to develop an IoT application for monitoring boiler plants, providing a user interface for real-time data analysis and statistics.
    - The application allows users to monitor multiple boiler plants, each located at different locations, through an intuitive interface.

2. Objectives:
    - Design and develop a user-friendly interface for boiler monitoring, enabling users to access and analyze real-time data.
    - Implement a data collection system to gather information from the boiler plants and display it on the user interface.
    - Test the application's functionality and performance using dummy data.

3. System Architecture:
    - The IoT application utilizes a distributed architecture, consisting of three main components: the user interface, the data collection module, and the data analysis module.
    - The user interface provides a dashboard that displays the information for the three boiler plants, each with its respective location.
    - The data collection module retrieves data from the boiler plants using IoT protocols and sends it to the cloud-based data analysis module.

4. Features and Use Cases:
    - The boiler monitoring application offers the following features:
        - Real-time monitoring of boiler plants with location-based categorization, allowing users to keep track of each boiler's performance.
        - Display of various statistics and performance indicators, such as temperature, pressure, and fuel consumption, for each individual boiler.
        - Analysis of historical and real-time data to identify patterns, detect anomalies, and predict potential failures.

5. Use cases for the application include:
        - Enabling maintenance personnel to remotely monitor boiler health and performance, allowing for proactive maintenance and reducing downtime.
        - Supporting data-driven decision-making for optimizing boiler efficiency, energy consumption, and overall plant performance.
        - Facilitating compliance with safety regulations by continuously monitoring critical parameters and promptly alerting in case of deviations.

6. Implementation Details:
    - The application was developed using a combination of programming languages (e.g., Python, JavaScript) and frameworks suitable for web and IoT development.

- The data collection mechanism involves establishing secure connections with the boiler plants and retrieving sensor data at regular intervals.
- The collected data is stored in a cloud-based database for further analysis and visualization on the user interface.

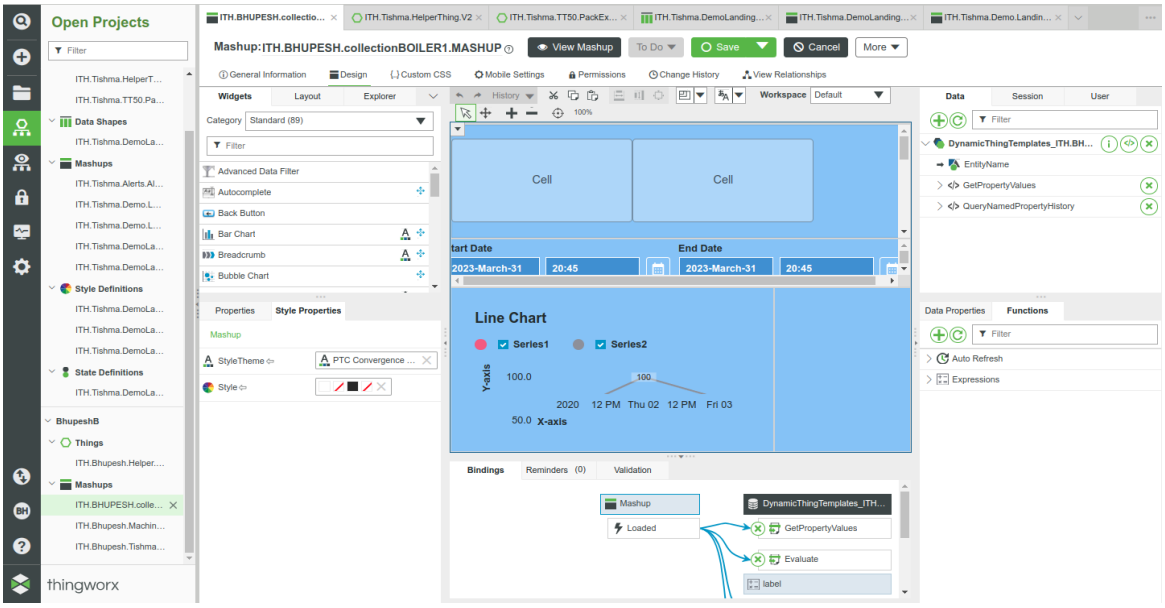
7. Results and Evaluation:
    - The application was tested using dummy data to assess its functionality and performance.
    - Performance metrics, such as response time and data accuracy, were measured and evaluated against predefined benchmarks.
    - The results demonstrate that the application effectively collects and presents real-time data, allowing for efficient monitoring and analysis.

8. Future Enhancements and Scalability:
    - Future enhancements for the application include:
        - Integration with actual boiler plants and live data feeds, enabling real-time monitoring of operational boilers.
        - Implementing predictive analytics algorithms to forecast potential boiler failures based on historical data patterns.
        - Integrating with other IoT devices, such as environmental sensors, for comprehensive facility management and energy optimization.
    - The application is designed to scale easily, allowing for the monitoring of a larger number of boiler plants and locations as the system grows.

9. Conclusion:
    - The developed IoT application for boiler monitoring showcases the potential of IoT technologies in improving operational efficiency and maintenance in industrial settings.
    - The application's intuitive user interface and real-time data analysis capabilities make it a valuable tool for monitoring and optimizing boiler performance.
    - With further enhancements and integration with real-world systems, the application holds promise for widespread adoption and industry-wide benefits.

Boiler Dashboard is a smart connected factory, multiple locations connected dashboard for monitoring and maintaining three Boiler plants. It is built on ptc Thingworx platform for IoT development. It is an industrial project assigned to me. It solves many modern day to day problems and helps in achieving more realistic and accurate real time data analysis insights of the Boiler plants.

Project Link -
https://iscpa.ithena.io/Thingworx/Runtime/index.html?mashup=ITH.BHUPESH.LandingPage.MASHUP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Workspace
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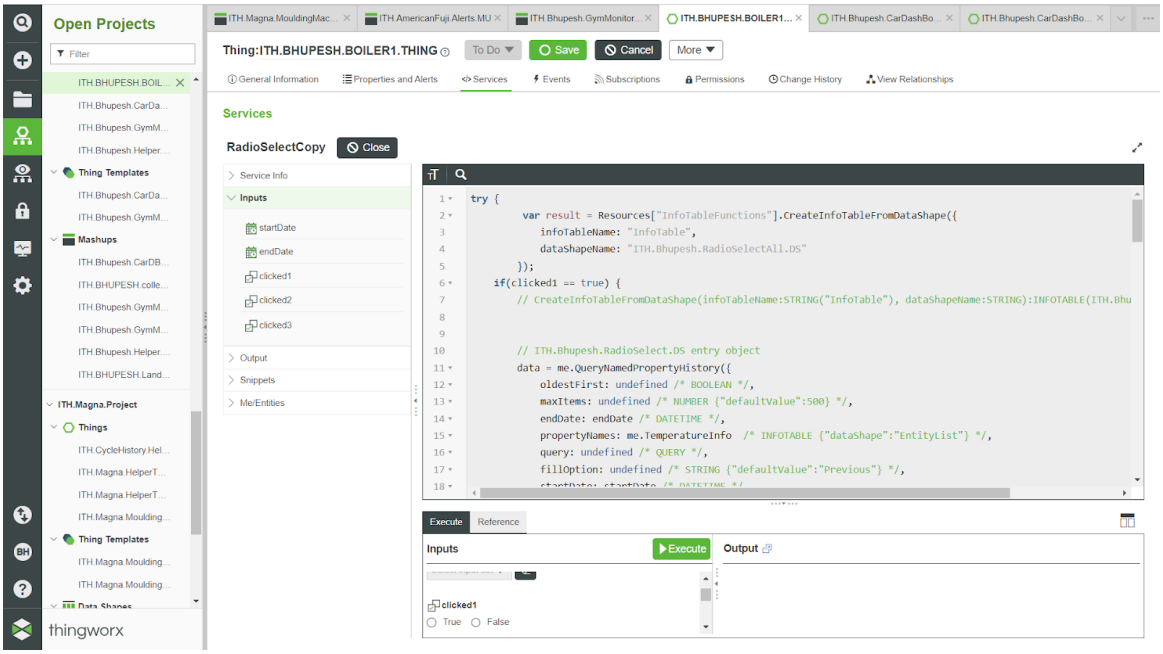
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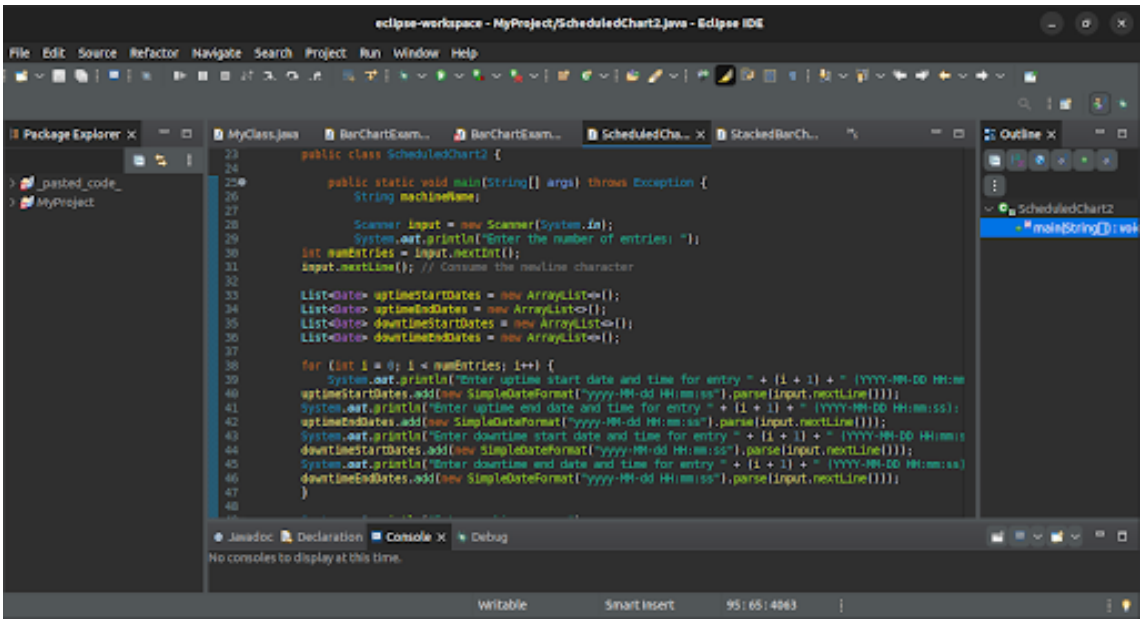
Change History
View Relationships
Services
RadioSelectCopy
Close
Service Info
Inputs
startDate
endDate
clicked1
clicked2
clicked3
Output
Snippets
Me/Entities
try {
var result = Resources["InfoTableFunctions"].CreateInfoTableFromDataShape({
infoTableName: "InfoTable",
dataShapeName: "ITH.Bhupesh.RadioSelectAll.DS"
});
if(clicked1 == true) {
// CreateInfoTableFromDataShape(infoTableName:STRING("InfoTable"), dataShapeName:STRING):INFOTABLE(ITH.Bhu
// ITH.Bhupesh.RadioSelect.DS entry object
data = me.QueryNamedPropertyHistory({
oldestFirst: undefined /* BOOLEAN */,
maxItems: undefined /* NUMBER {"defaultValue":500} */,
endDate: endDate /* DATETIME */,
propertyNames: me.TemperatureInfo /* INFOTABLE {"dataShape":"EntityList"} */,
query: undefined /* QUERY */,
fillOption: undefined /* STRING {"defaultValue":"Previous"} */,
Execute
Reference
Inputs
Execute
Output
clicked1
True
False
thingworx


eclipse-workspace - MyProject/ScheduledChart2.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
Package Explorer
MyClass.java
BarChartExam...
BarChartExam...
ScheduledCha...
StackedBarCh...
Outline
_pasted_code_
MyProject
public class ScheduledChart2 {
public static void main(String[] args) throws Exception {
String machineName;
Scanner input = new Scanner(System.in);
System.out.println("Enter the number of entries: ");
int numEntries = input.nextInt();
input.nextLine(); // Consume the newline character
List<Date> uptimeStartDates = new ArrayList<>();
List<Date> uptimeEndDates = new ArrayList<>();
List<Date> downtimeStartDates = new ArrayList<>();
List<Date> downtimeEndDates = new ArrayList<>();
for (int i = 0; i < numEntries; i++) {
System.out.println("Enter uptime start date and time for entry " + (i + 1) + " (YYYY-MM-DD HH:m
uptimeStartDates.add(new SimpleDateFormat("yyyy-MM-dd HH:mm:ss").parse(input.nextLine()));
System.out.println("Enter uptime end date and time for entry " + (i + 1) + " (YYYY-MM-DD HH:mm:ss):
uptimeEndDates.add(new SimpleDateFormat("yyyy-MM-dd HH:mm:ss").parse(input.nextLine()));
System.out.println("Enter downtime start date and time for entry " + (i + 1) + " (YYYY-MM-DD HH:mm:s
downtimeStartDates.add(new SimpleDateFormat("yyyy-MM-dd HH:mm:ss").parse(input.nextLine()));
System.out.println("Enter downtime end date and time for entry " + (i + 1) + " (YYYY-MM-DD HH:mm:ss)
downtimeEndDates.add(new SimpleDateFormat("yyyy-MM-dd HH:mm:ss").parse(input.nextLine()));
ScheduledChart2
main(String[]) : voi
Javadoc
Declaration
Console
Debug
No consoles to display at this time.
Writable
Smart Insert
95 : 65 : 4063

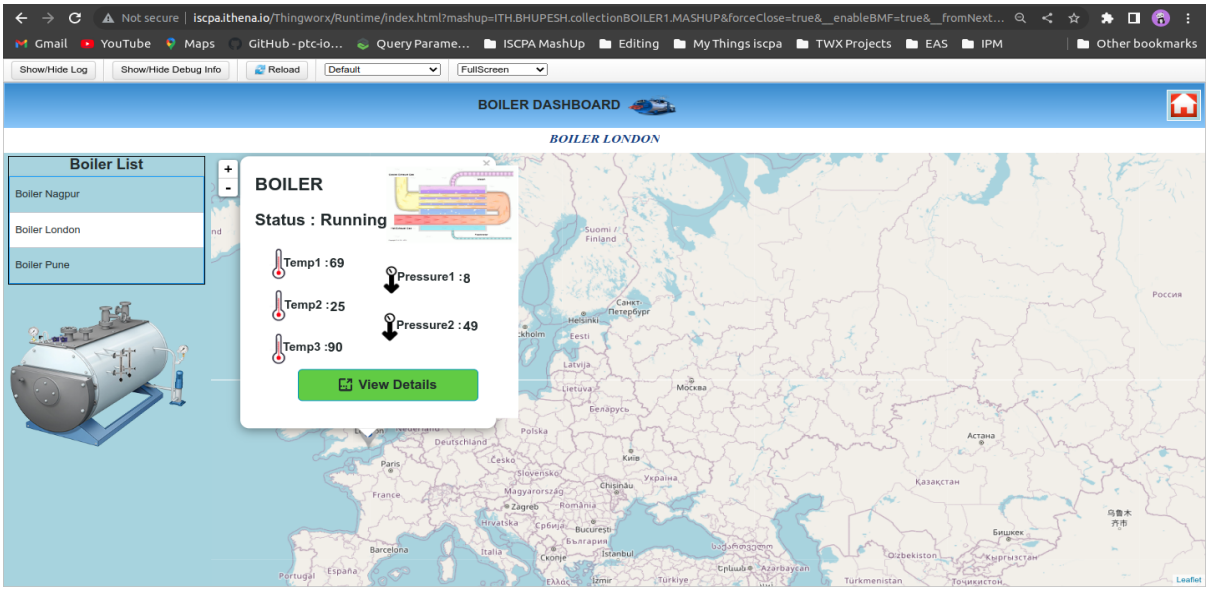
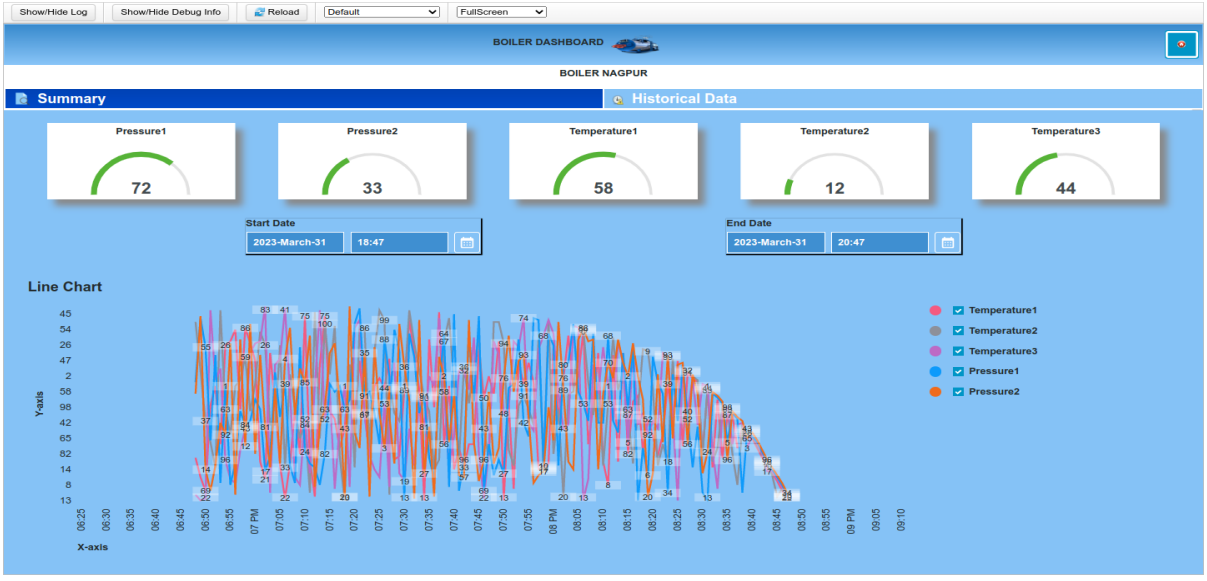
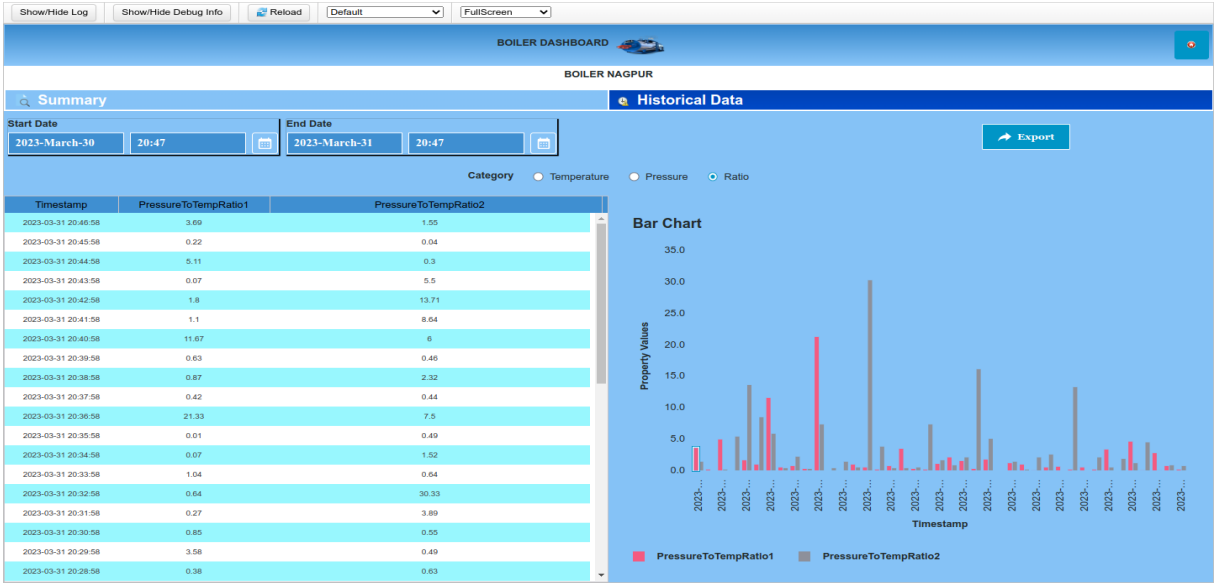


Fig 5.1 Boiler Dashboard





CHAPTER 6

THINGWORX PROJECT 3 – GYM MONITORING.

Project Overview -

- ➢ The Gym Monitoring project is an innovative system designed to track and analyze the fitness activities of individuals within a gym setting. The project encompasses two main components: personal fitness monitoring and gym machine interface.

- ➢ The personal fitness monitoring component captures and stores individual details, including personal information and physical fitness data. This includes parameters such as heart rate, calorie consumption, water intake level, and total calories burnt. These metrics are continuously monitored and updated in real-time, allowing users to track their progress and make informed decisions regarding their fitness goals.

- ➢ The gym machine interface provides a centralized platform for the gym administrator to oversee the availability and usage of various gym machines. It displays real-time information about each machine, including occupancy status, remaining repetitions and sets, total calories burnt, and time taken on each machine. This interface enables efficient management of machine utilization and allows users to plan their workouts effectively based on machine availability and usage statistics.

- ➢ Additionally, the project incorporates a performance metrics section, providing users with comprehensive insights into their fitness progress. This includes metrics such as total calories burnt, hours spent in the gym throughout the week, and other performance indicators. These metrics help users evaluate their overall performance, set new goals, and make data-driven decisions to optimize their fitness routines.

- ➢ Overall, the Gym Monitoring project offers a holistic solution for both individuals and gym administrators. It empowers users to monitor their personal fitness levels, set targets, and track their progress over time. Simultaneously, the gym machine interface facilitates effective resource management and allows administrators to optimize machine usage based on real-time data. By combining personal fitness monitoring, machine tracking, and performance metrics, this project enhances the gym experience, promotes accountability, and supports individuals in achieving their fitness goals.

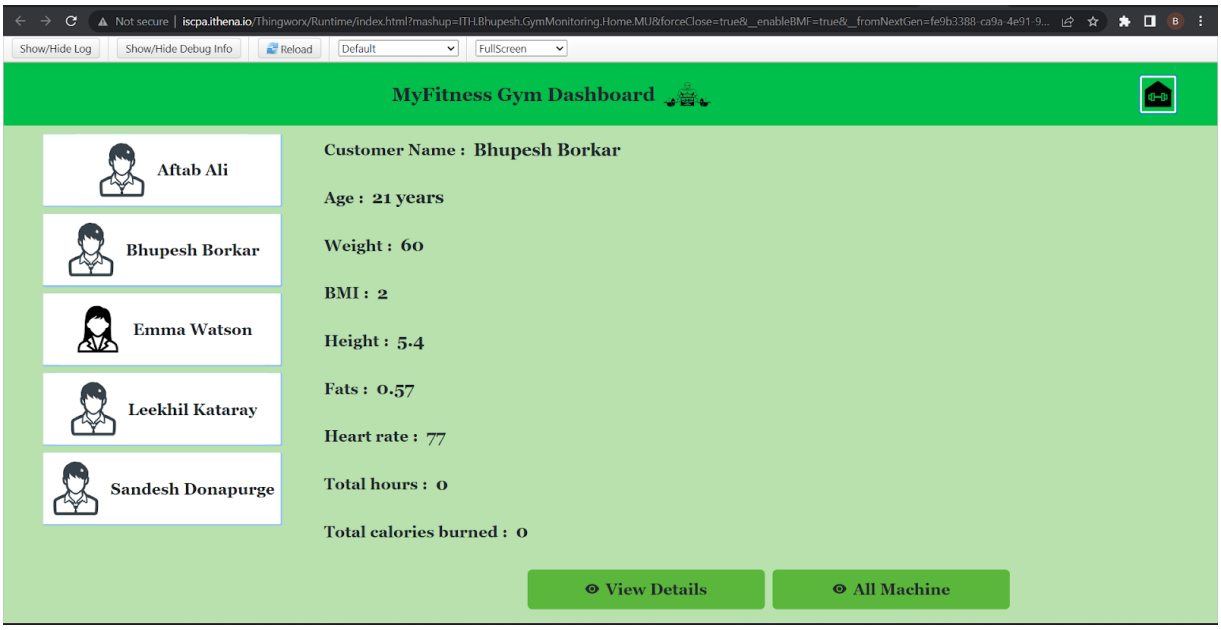
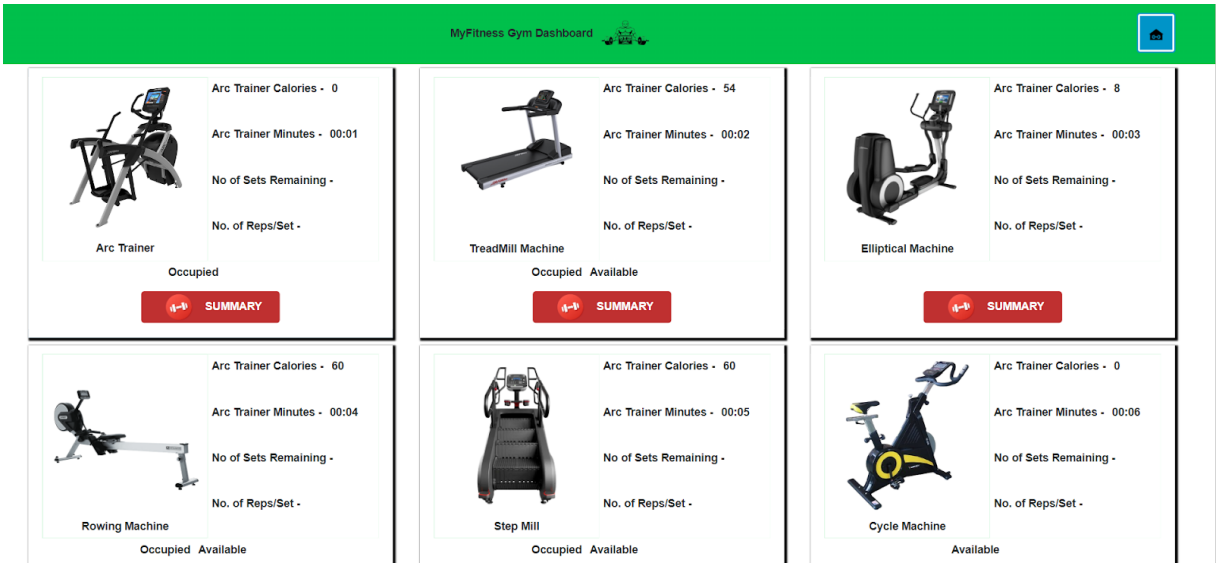
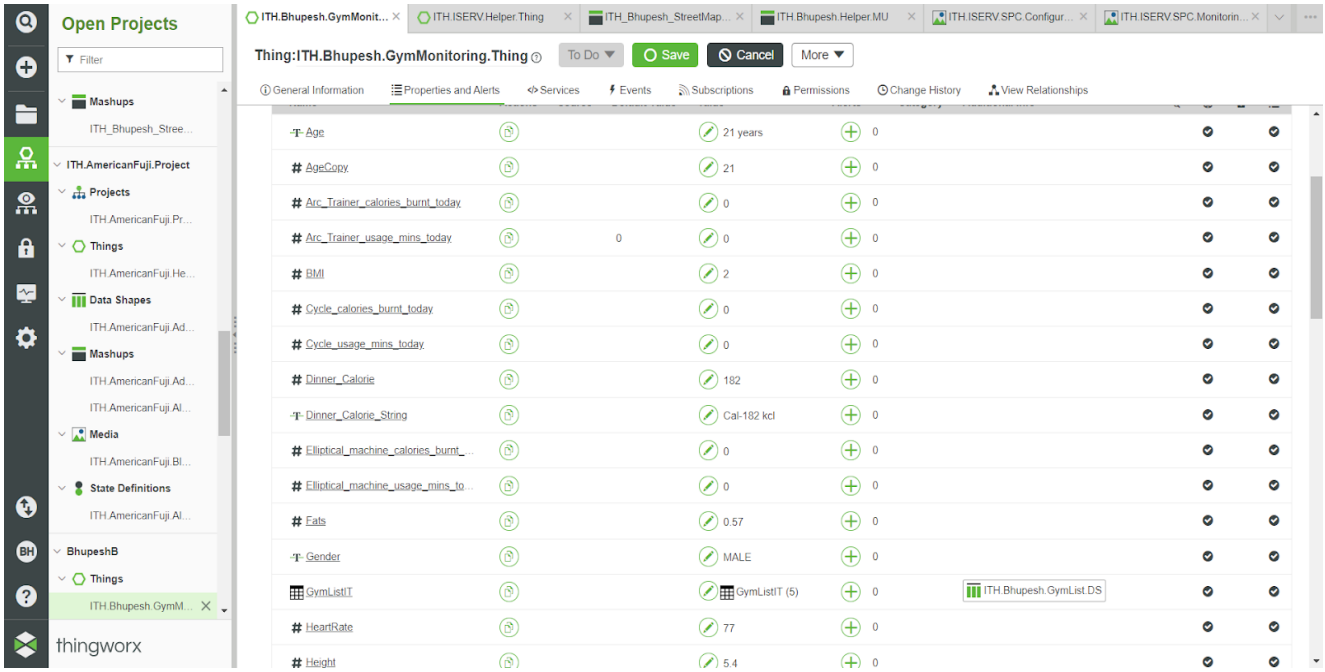


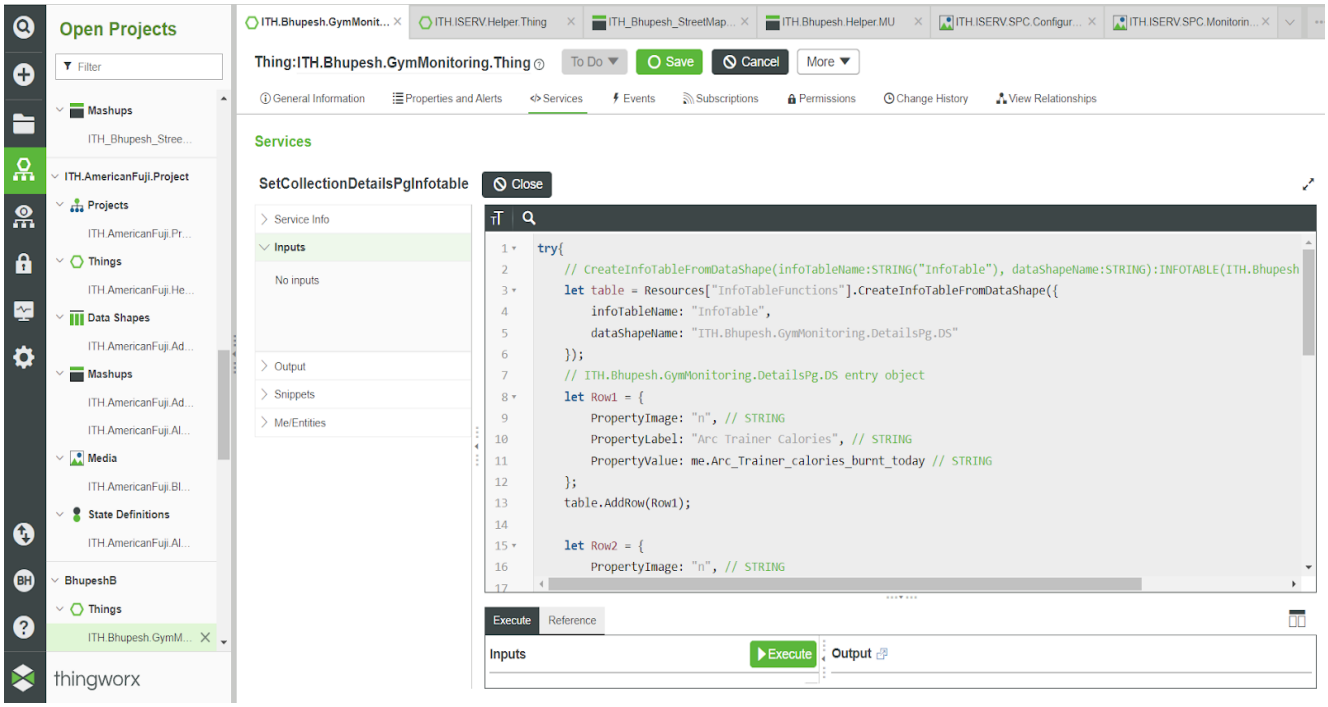
Fig 6.1 : Gym Monitoring Dashboard



Real time data -



Programming Interface -



CHAPTER 7

BENEFITS OF IOT

What industries can benefit from IoT?

Organizations best suited for IoT are those that would benefit from using sensor devices in their business processes.

Manufacturing
Manufacturers can gain a competitive advantage by using production-line monitoring to enable proactive maintenance on equipment when sensors detect an impending failure. Sensors can actually measure when production output is compromised. With the help of sensor alerts, manufacturers can quickly check equipment for accuracy or remove it from production until it is repaired. This allows companies to reduce operating costs, get better uptime, and improve asset performance management.

Automotive
The automotive industry stands to realize significant advantages from the use of IoT applications. In addition to the benefits of applying IoT to production lines, sensors can detect impending equipment failure in vehicles already on the road and can alert the driver with details and recommendations. Thanks to aggregated information gathered by IoT-based applications, automotive manufacturers and suppliers can learn more about how to keep cars running and car owners informed.

Transportation and Logistics
Transportation and logistical systems benefit from a variety of IoT applications. Fleets of cars, trucks, ships, and trains that carry inventory can be rerouted based on weather conditions, vehicle availability, or driver availability, thanks to IoT sensor data. The inventory itself could also be equipped with sensors for track-and-trace and temperature-control monitoring. The food and beverage, flower, and pharmaceutical industries often carry temperature-sensitive inventory that would benefit greatly from IoT monitoring applications that send alerts when temperatures rise or fall to a level that threatens the product.

Retail
IoT applications allow retail companies to manage inventory, improve customer experience, optimize supply chain, and reduce operational costs. For example, smart shelves fitted with weight sensors can collect RFID-based information and send the data to the IoT platform to automatically monitor inventory and trigger alerts if items are running low. Beacons can push targeted offers and promotions to customers to provide an engaging experience.

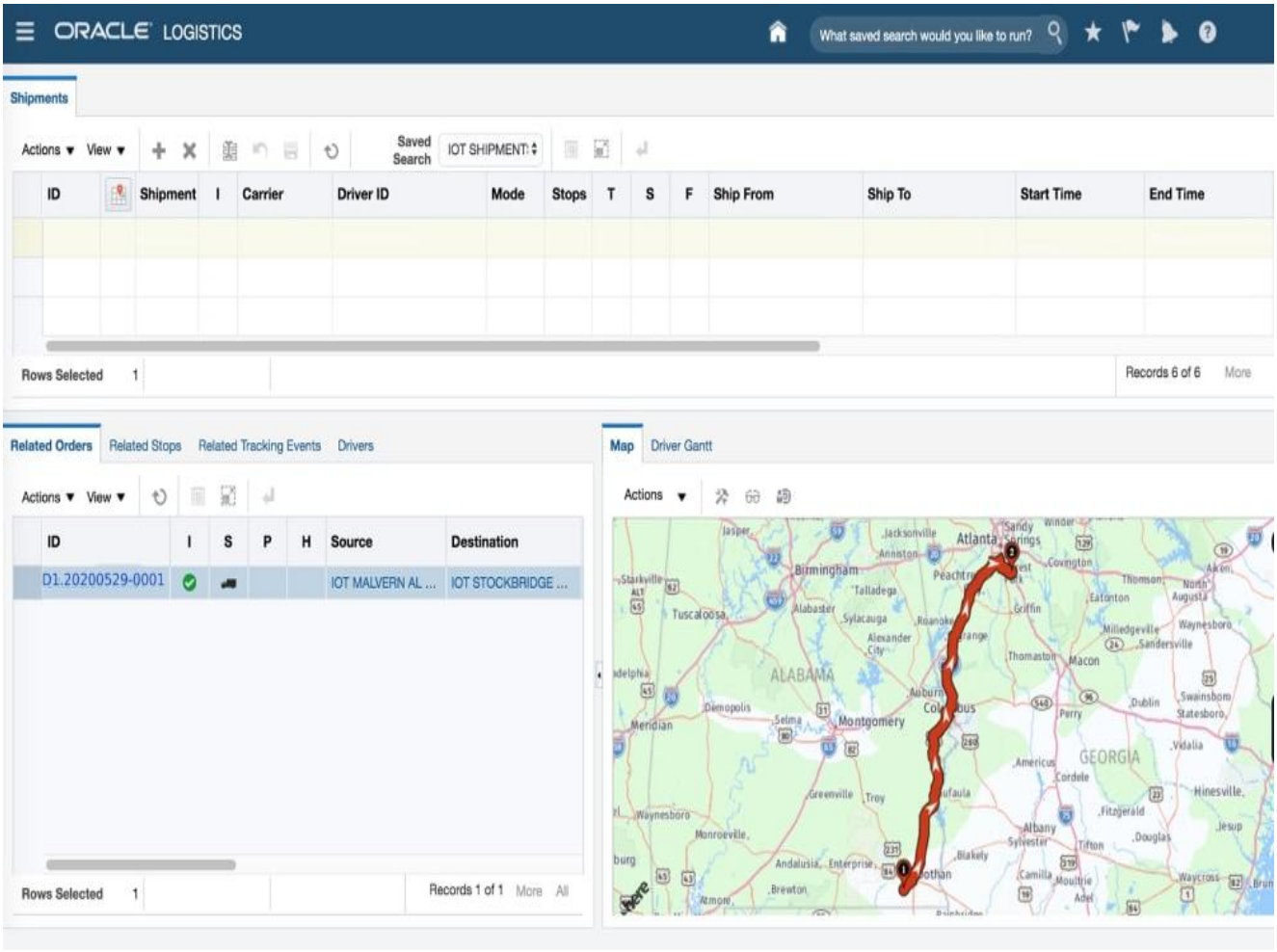
Public Sector
The benefits of IoT in the public sector and other service-related environments are similarly wide-ranging. For example, government-owned utilities can use IoT-based applications to notify their users of mass outages and even of smaller interruptions of water, power, or sewer services. IoT applications can collect data concerning the scope of an outage and deploy resources to help utilities recover from outages with greater speed.

Healthcare

IoT asset monitoring provides multiple benefits to the healthcare industry. Doctors, nurses, and orderlies often need to know the exact location of patient-assistance assets such as wheelchairs. When a hospital's wheelchairs are equipped with IoT sensors, they can be tracked from the IoT asset-monitoring application so that anyone looking for one can quickly find the nearest available wheelchair. Many hospital assets can be tracked this way to ensure proper usage as well as financial accounting for the physical assets in each department.

General Safety Across All Industries

In addition to tracking physical assets, IoT can be used to improve worker safety. Employees in hazardous environments such as mines, oil and gas fields, and chemical and power plants, for example, need to know about the occurrence of a hazardous event that might affect them. When they are connected to IoT sensor–based applications, they can be notified of accidents or rescued from them as swiftly as possible. IoT applications are also used for wearables that can monitor human health and environmental conditions. Not only do these types of applications help people better understand their own health, they also permit physicians to monitor patients remotely.



How is IoT changing the world? Take a look at connected cars.

IoT is reinventing the automobile by enabling connected cars. With IoT, car owners can operate their cars remotely—by, for example, preheating the car before the driver gets in it or by

remotely summoning a car by phone. Given IoT's ability to enable device-to-device communication, cars will even be able to book their own service appointments when warranted.

The connected car allows car manufacturers or dealers to turn the car ownership model on its head. Previously, manufacturers have had an arms-length relationship with individual buyers (or none at all). Essentially, the manufacturer's relationship with the car ended once it was sent to the dealer. With connected cars, automobile makers or dealers can have a continuous relationship with their customers. Instead of selling cars, they can charge drivers usage fees, offering a "transportation-as-a-service" using autonomous cars. IoT allows manufacturers to upgrade their cars continuously with new software, a sea-change difference from the traditional model of car ownership in which vehicles immediately depreciate in performance and value.

CHAPTER 8

SUMMARY AND CONCLUSION

Throughout my internship as an IoT ThingWorx developer, I have gained invaluable knowledge and hands-on experience in developing IoT applications using the ThingWorx platform. This internship has provided me with a deep understanding of the IoT ecosystem, data integration, analytics, and application development.

During my internship, I actively participated in various stages of IoT application development. I gained proficiency in configuring ThingWorx entities such as Thing Templates, Thing Shapes, and Thing Properties, enabling the representation of connected devices within the system. One of the highlights of my internship was working on data ingestion and storage. I had the opportunity to explore data processing and analytics using ThingWorx Analytics and ThingWorx Analytics Builder, where I defined data models, rules, and analytics algorithms.

The application development phase was a crucial aspect of my internship. Utilizing ThingWorx Composer, I designed user interfaces, created Mashups, and configured services and events to enhance interactivity and real-time updates. Implementing robust security measures using ThingWorx Security was also an essential part of ensuring secure access to the applications.

Throughout the internship, I collaborated closely with my internship mentor and the talented team at ITHENA Technologies. Their guidance, expertise, and support have been invaluable in shaping my skills as an IoT ThingWorx developer. The collaborative work environment and opportunities to work on real-world projects have immensely contributed to my professional growth.

Working alongside experienced professionals provided me with valuable insights into industry best practices and enhanced my problem-solving abilities.

I extend my heartfelt gratitude to ITHENA Technologies, my internship supervisor, and all the team members who supported and mentored me throughout this journey. I am thankful for the opportunity to contribute to the organization's projects and make a meaningful impact.

APPENDIX A
INTERNSHIP OFFER LETTER

September 07, 2022
Ref: HR/2022-23/OLI-IN13

Candidate Name : Bhupesh Milind Borkar

Sub: Internship Offer

Dear Bhupesh,

On behalf of Ithena Technologies Pvt. Ltd, I am pleased to extend to you this offer of temporary employment as an **Trainee-Software Developer** reporting to the Technical Director. If you accept this offer, you will begin your 6 months internship with the Company from **January 1, 2023**, and you will be expected to work Monday to Friday.

Please report at **10:00 am** and your work location will be Ithena India office, address which is given below:

ITHENA Technologies Private Limited
6TH FLOOR AMAR MADHUBAN TECH PARK
OPP AUDI SHOWROOM BANER PUNE:45

Please note that it is important to be on time to complete the joining formalities. On or before your joining date, please send self-attested scan copies of the following documents along with the attached joining form with this mail.

- Highest education degree certificate / provisional degree certificate and consolidated/ All semester mark sheets. Photocopies/scan copies should include both front and back sides of certificate.
- Relieving letter/ Experience Letter / Resignation acceptance letter from your most recent employer. If you have been employed for 1 year or less with the most recent employer, you must also bring a relieving letter/experience Letter from the prior employer. Include your employee number with such previous employer(s).
- Proof of identity: passport, driving license, voter's identification card, PAN card, or credit card with photograph.
- Copy of Pan Card & Aadhar Card is mandatory. Photocopies/scan copies should include both front and back sides of certificate.
- If you have ever changed your name at any point of time, and for any reason whatsoever, please bring supporting documents for the same.
- All the above documents are mandatory, and you will not be allowed to join without them.
- On your joining date, please bring the original documents for verification purpose.

You will be paid stipend of Rs**. 15200/-** per month, [Rupees Fifteen Thousand Two Hundred Only] less all applicable taxes and withholdings, payable. As an intern you will be receive "temporary employment" status. As a temporary employee, you will not receive any of the employee benefits that regular Company employees receive, including, but not limited to, health insurance, vacation or sick pay, paid holidays.

If you decided to leave the Company, for any reasons, you are required to serve the company a thirty days' notice in writing or thirty days' stipend in lieu of your notice period. If the company decides to terminate your employment, the company will likewise give you a thirty days' notice in writing.

ITHENA Technologies Private Limited
Corporate & Registered Office: 401 Aquila Classique, Ramnagar Colony, Bavdhan, Pune 411021, India.
Phtwo: + 91 7888 03 6665 | ITHENA@ITHENA.ai | www.ITHENA.ai | CIN: U72900PN2019PTC186412

The company reserves the right to make a payment in lieu of notice or its proportionate shortfall computed on basis salary only (as the case may be) should it decide to terminate this letter of appointment. The company reserves the right to hold you back in service or stop you from seeking any alternate employment during the three months' notice period even if you so choose to pay the company, compensation in lieu of notice period.

You are not entitled for any leaves/compensation benefits during your notice period as per clause mentioned in exit policy.

You are also not entitled for any experience or relieving letter if you leave company without completing your 6 months internship.

The training period may be extended by the Company at its discretion. On satisfactory completion of the training and after reviewing your performance you shall be appointed as an employee. The company may but is not bound to offer you employment at any time during training period or after three months of training period, having evaluated your association with the company in terms of your core performance, attitude, work habits and professional competence.

During your internship, you may have access to trade secrets and confidential business information belonging to the Company. By accepting this offer of temporary employment, you acknowledge that you must keep all this information strictly confidential, and refrain from using it for your own purposes or from disclosing it to anyone outside the Company. In addition, you agree that, upon conclusion of your temporary employment, you will immediately return to the Company all its property, equipment, and documents, including electronically stored information.

By accepting this offer, you agree that throughout your internship, you will observe all policies and practices governing the conduct of our business and employees, including our policies prohibiting discrimination and harassment. This letter sets forth the complete offer we are extending to you and supersedes and replaces any prior inconsistent statements or discussions. It may be changed only by a subsequent written agreement.

I hope that your association with the Company will be successful and rewarding. Please indicate your acceptance of this offer by signing below and returning it.

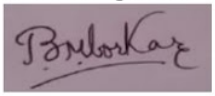
Yours sincerely,

For: ITHENA Technologies Private Limited

Sanjivani Kulkarni
Head-HR

I accept employment with the Company on the terms and conditions set out in this letter.

Name & Signature:



BHUPESH MILIND BORKAR
Date: September 07, 2022

APPENDIX B

INTERNSHIP ONGOING CERTIFICATE

5/17/23, 1:32 PM ithena.ai Mail - Internship Update - Bhupesh Borkar

Bhupesh Borkar <bhupeshb@ithena.ai>

Internship Update - Bhupesh Borkar

1 message

Swarnima Anjalkar <swarnimaa@ithena.ai> Tue, May 16, 2023 at 1:31 PM
To: head.cse@sggs.ac.in, psnalwade@sggs.ac.in
Cc: Sanjivani Kulkarni <sanjivanik@ithena.ai>, Bhupesh Borkar <bhupeshb@ithena.ai>, Shriniwas Waphare <shriniwasw@ithena.ai>

Respected Madam/ Sir,

Greetings from Ithena Technologies!

I am the HR Executive at Ithena Technologies Pvt. Ltd.
I am writing this email to inform you regarding the status of Bhupesh Borkar's internship at our company.

Bhupesh started his 6 months internship on 02/01/2023. He is currently in his 5th month of his internship period. We can provide him with an internship completion certificate once he has successfully completed his internship. We cannot issue an internship certificate before completion of his internship.

This email is sent on the request of Bhupesh Borkar.

Feel free to get in touch with me if you have any questions.

Thanks & Regards,

Swarnima Anjalkar
HR Executive
+91-7821015273

www.ithena.ai

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APPENDIX C

NON-DISCLOSURE AGREEMENT (NDA)

5/14/23, 10:23 PM ithena.ai Mail - Confirming to the NDA during your Internship Project Thesis and demonstration and at other public forums

ithena

Bhupesh Borkar <bhupeshb@ithena.ai>

Confirming to the NDA during your Internship Project Thesis and demonstration and at other public forums

Shriniwas Waphare <shriniwasw@ithena.ai> Thu, May 11, 2023 at 12:23 PM
To: Bhupesh Borkar <bhupeshb@ithena.ai>
Cc: Swarnima Anjalkar <swarnimaa@ithena.ai>

Dear Bhupesh,

This is to inform you that during your Internship Project Thesis and demonstration and at other public forums you are allowed to share and discuss resources on -

- Thingworx Platform, its working, architecture and design
- The case studies that you did during your training period, namely - Boiler, Gym and car dashboards
- Connectivity related protocols

Anything apart from what is mentioned above that you are working on in the ongoing or past customer projects or internal products is highly confidential and cannot be disclosed to anyone outside Ithena as per our non disclosure agreement.

Thank you for your support and time during this internship, looking forward to your improvement and delivering high quality output.

--
Warm Regards,
Shriniwas W.
+91 744 744 6613

ithena
Monetize on Digital

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