# IOT MANAGER - EDGE MANAGEMENT

A PROJECT REPORT

*Submitted by*

**MOHAMMED SHIBILI O (TKM21MCA-2029)**

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**DEPARTMENT OF COMPUTER APPLICATIONS**

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# DECLARATION

I undersigned hereby declare that the project report on **IOT MANAGER - EDGE MANAGEMENT**, submitted for partial fulfillment of the requirements for the award of degree of Master of Computer Application of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of **Prof. Vaheetha Salam**. This submission represents my ideas in my own words and where ideas or words of others have been included,I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in our submission. I understand that any violation of the above will be a cause for disciplinary action by the institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not previously served as the basis for the award of any degree, diploma, or similar title by any other University.

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**2021 - 23**

## CERTIFICATE

This is to certify that the report entitled **IOT MANAGER - EDGE MANAGEMENT** submitted by **MOHAMMED SHIBILI O** (TKM21MCA-2029) to the APJ Abdul Kalam Technological University in partial fulfillment of the Masters degree in Computer Application is a bonafide record of the project work carried out by him under our guidance and supervision. This report, in any form, has not been submitted to any other University or Institute for any reason.

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Date:17-05-2023

TO WHOM IT MAY CONCERN

This is to certify that Mr. Mohammed Shibili O from TKM College of Engineering, Kollam has completed the internship on **"IoT Manager"** project at **Knowledge Lens Pvt Ltd** from 16th January 2023 to 16th May 2023. During the period of his training with us he was found punctual, hardworking, and inquisitive.

We wish him all the success in future endeavors.

Yours Truly,

For **Knowledge Lens Pvt Ltd**.

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# ABSTRACT

**IOT MANAGER - EDGE MANAGEMENT** is a portal that is designed for performing several operations on data in the platform and to provide alerts to different users . The system comprises Rule setup and Alarm setup modules. Enables the admins to perform the logics or calculations on data which will help the user to meet their requirements. Alarms are customizable and the admin can set up on what condition the alarm should be triggered, the type of notification and to which user the alarm is to be sent. Rule templates and rule functions can be created for making rule creation more easier.

The rule and alarm setup developed for the platform is a crucial component, providing users the calculations and alerts according to their needs. Admins can create, view, and edit all the rules and alarm setup in the platform. Creating rules also helps to calculate virtual parameters and reduce the number of equipment required to make the measurement, which helps in reducing the total cost drastically. The Rule functions allow the user to write a custom piece of code which can be later used in setting up the rule. Creation of a large number of rule blocks in one rule can be made possible through the rule template.

The Asset Manager module offers industries a holistic representation of their equipment, encompassing its parameters, processes, materials, and resources. This facilitates efficient asset management, performance optimization, and downtime reduction. Moreover, the alarm and rule setup module empowers users to establish rules for monitoring each device, which can activate alarms upon reaching predefined thresholds.

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# Chapter 1

# Introduction

**IOT MANAGER - EDGE MANAGEMENT** is a platform that efficiently manages data coming from different IoT devices in an industry. The Industrial Internet of Things (IIoT) involves dealing with large volumes of data produced by interconnected devices and machinery in real-time, making efficient data management critical. Proper data management enables effective acquisition, processing, retention, and interpretation of this data, leading to valuable insights and improved industrial processes.

Effective data management facilitates the enhancement of productivity, reduction in expenses, increased uptime, better quality control, and overall business development. It also ensures data security, privacy, and compliance with regulatory guidelines. By collecting and analysing data from IoT devices, organisations can gain valuable insights into their operations and make data-driven decisions. Proper data management ensures that IoT data is accurate, reliable, and accessible, providing organisations with the confidence to make decisions based on this data.

IoT Manager-Edge Management provides the space for creating rules and alarms that meet the user's needs. The platform contains features like rule setup, alarm setup, rule functions, and rule templates. Setting up rules helps to calculate and store new process parameters, which helps the production, maintenance, or management team understand and make the right decisions. Creating rules also helps to calculate virtual parameters, reducing the number of equipment required to make the measurement, which helps in reducing the total cost drastically.

Alarm systems signal to the managers the irregular conditions and problems of the plant and equipment, allowing them to take corrective measures and restore the plant/equipment to normal conditions. This helps in effective running, increased production, and efficiency of the equipment. Rule functions allow the user to write a custom piece of code that can be later used in setting up the rule. The Rule Template feature has been developed to support bulk creation/upload of rules.

The device management module of this project provides a comprehensive overview of all on-site deployed devices in one place. Every device transmits heart-beat messages, which are captured to obtain real-time data, accessible for users to view and control via the user interface. The analysis of the last sync data helps determine the device's status, whether it's online or offline. All heart-beat messages are stored in MongoDB. If a device fails to transmit heart-beat data within a specific time frame, it is regarded as offline.

Access to the platform is granted to users based on their privileges, with custom roles created and specific privileges assigned to each role. Super administrators are responsible for authorising user access, and only authorised users are allowed to log into the system. The Asset Management module is designed to facilitate the configuration of assets and their corresponding parameters, covering all equipment used throughout a project. It enables users to create and allocate parameters and units specific to each piece of equipment in a straightforward manner. Furthermore, the system boasts a valuable asset modelling feature that promotes reusability, where users need only create an asset model once, even if the site has multiple plants.

One of the key benefits of IoT Manager is the real-time data management and alerts, which is essential for organisations looking to leverage the potential of IoT technology to improve their operations, gain a competitive edge, and ensure data security and compliance. Real-time device monitoring is also an important phase of IoT Manager, which helps to monitor the IoT devices remotely. Overall, IoT Manager enriches all phases of the industrial lifecycle, including machines, maintenance, production, and more.

## 1.1 Company Profile

The set of Lenses offered by Knowledge Lens makes it easier and automates the process of discovering insights from Big Data. Our ultimate aim is to unlock the potential of dark data and convert it into actionable business intelligence. As passionate big data technology experts, we have worked on a wide variety of big data projects, spanning from engineering to data science, and have extensive industry-specific knowledge to support our clients.

### 1.1.1 Products

- **UnifyTwin**

  Across the industrial life cycle, UnifyTwin's Intelligent Industrial App Suite, powered by AI, serves the needs of its customers. UnifyTwin is acknowledged in the Gartner quadrant and has been validated by hundreds of industrial clients in numerous industries.

- **Glens**

  Software for the real-time capture, monitoring, and analysis of environmental data, Analytics for Centralized Monitoring, Web HMI, Connectivity Solution, Device Data Acquisition, Industrial App Platform, and Analyses of Environmental Data.

- **Mlens**

  You can manage disaster recovery for your big data and platforms with MLens, a one-step solution. Aspects of MLens:

  1. Migration of Big Data Backup
  2. Disaster Recovery Automation
  3. Archival, compression, and data encryption
  4. Rapid Data Ingestion in Batch
  5. Controlling and Planning
  6. Secured Access Control

### 1.1.2 Services

- **Services for Big Data Engineering**

  We offer full-service big data protection architecture, design, development, testing, and deployment.

- **Services for Big Data Security**

  We are one of the specialized consulting firms offering Big Data Services.

- **Services for Big Data Analytics**

  Using our pre-built analytical Lens, we deliver hidden insights from a wide range of data sources.

- **Services for the Development of Big Data Competencies**

  We offer one of the top enterprise big data competency development programs without specialized big data knowledge.

## 1.2 Existing System

The software program was developed six years ago using outdated technology to address challenges related to the management of remote edge and IoT devices. It provided a centralized platform for users to easily monitor, control, and configure extensive networks of devices. However, as technology has advanced, it has become evident that the older technology used in the application has its limitations.

The outdated technology may struggle to handle the increasing volume of data generated by IoT devices and comply with the latest security requirements, potentially impacting scalability. Moreover, the user interface may not be as modern or intuitive, making it difficult for users to efficiently access and analyze their equipment data. Modern applications now offer advanced analytics and machine learning capabilities that surpass the capabilities of the existing application.

While the previous version of the software offered a practical solution for managing remote endpoints and IoT devices, its ability to adapt, provide robust security, and meet evolving user needs may be hindered by its outdated technology. It becomes crucial to enhance the application using modern technologies and functionalities to align with the latest requirements for managing IoT devices in today's digital landscape.

## 1.3 Proposed System

The proposed system helps people look after and keep track of their IoT devices. It is a very helpful and complete tool. This tool helps people see how well their device is working right now. They can fix any problems they find right away.

- Login and Persona Management: The platform offers a custom login system that provides access to users with appropriate privileges. Users can log in using Google or custom login, and forgot password and reset password functionality is provided for normal login users. The platform includes custom roles and super admins who have privileges to create, view, and update users and user roles.

- Asset Manager: The Asset Manager module provides a comprehensive model of each piece of equipment and its associated parameters, processes, materials, and resources. This module allows industries to more effectively manage their assets, optimize performance, and reduce downtime. By providing real-time insights into asset performance and maintenance needs, the Asset Manager module empowers industries to make data-driven decisions and improve overall operations.

- Alarm and Rule Setup: The platform allows users to create rules to monitor each device, acting as thresholds. When a certain threshold is reached, alarms are triggered. Rule templates generated can be used for multiple similar scenarios, and rule functions allow users to reuse code created for similar purposes.

- Real-time Alerts and Notifications: The platform sends real-time alerts and notifications to users when a device is offline or when a rule is triggered. Export Data and Generate Reports: The platform provides the ability to export data and generate reports for device monitoring and management purposes.

## 1.4 Objectives

Project deliverable includes:

- Develop features for rule creation.

- Develop alarm setup for giving real-time alerts.

- Rule function to write a custom piece of code which can be used later.

- Rule Template feature to support bulk creation/upload of rules.

- Increase productivity and create a user-friendly platform.

# Chapter 2

# Literature Survey

A literature review involves conducting a thorough analysis and interpretation of existing literature on a specific subject. It serves the purpose of formulating research questions and seeking answers by examining relevant literature. The process often leads to new insights through the re-evaluation of study results, which is a notable advantage of literature reviews. Essentially, a literature review provides a summary and explanation of the current state of knowledge on a subject, as presented in academic books and journal articles. In college, there are two types of literature reviews: one is an independent assignment within a course, and the other serves as an introduction or preparatory work for a longer piece such as a thesis or research report. The focus, perspective, and formulation of a clear hypothesis or thesis argument depend on the type of review being written. To understand the differences between these two types, one can study published literature reviews or examine the introductory chapters of relevant theses and dissertations, noting the structure of their arguments and their approach to the issues at hand.

## 2.1 Purpose of the Literature Review

1. Identifying the research gap: Researchers review existing literature to determine what has already been studied and identify areas that have not been adequately explored. This process helps in defining the scope and objectives of a new research project.

2. Understanding the context: Literature surveys provide researchers with a historical and theoretical context for their work. They can identify key concepts, theories, methodologies, and debates within the field, allowing them to position their research in relation to previous studies.

3. Evaluating existing research: A literature survey involves critically assessing the quality, reliability, and validity of published studies. Researchers analyse the methodologies used, strengths and limitations, and the overall contribution of each study to the field.

This evaluation helps in identifying areas of consensus, controversies, and gaps in knowledge.

4. Synthesising findings: Researchers synthesise the findings from various studies to develop a comprehensive overview of the topic. They identify common themes, patterns, and emerging trends across the literature, which can inform future research directions and hypotheses.

5. Supporting research methodology: Literature surveys aid in selecting appropriate research methods and techniques. By understanding the existing literature, researchers can determine the most effective ways to collect data, analyse findings, and interpret results.

## 2.2 Related Works

### 2.2.1 Internet of Things (IoT)

The Internet of Things (IoT) is a network of interconnected devices that can collect and exchange data, enabling them to communicate and interact with each other and users. It revolutionizes industries, homes, and cities by improving efficiency, automation, and decision-making. IoT has the potential to transform how we live and work, offering benefits such as enhanced productivity, optimized resource allocation, and improved quality of life. The paper titled ”The Internet of Things in the Oil and Gas Industry: A Systematic Review” investigates how IoT technologies drive innovation in the OG industry. The authors acknowledge the industry’s need for innovation to address business goals, such as risk reduction and cost optimization. They discuss the concept of Industry 4.0 and its impact on the OG sector, highlighting key technologies that have been invested in.The limitations of traditional systems like SCADA and WSNs in the OG industry are recognized, and the potential of IoT to overcome these limitations is explored. The paper also covers the widespread adoption of IoT in various sectors and its disruptive effect on traditional business models.The main focus is on reviewing the current research status of IoT in the OG industry, including opportunities and challenges in upstream, midstream, and downstream operations. Opportunities include asset monitoring and predictive maintenance, while challenges encompass interoperability and data security[1].

A Predictive Maintenance Model for Optimal Asset Management in Industry 4.0 Using

IoT and Fog Computing presents an innovative approach to asset management in Industry 4.0. It integrates IoT, fog computing, and machine learning to enable predictive maintenance and enhance asset reliability.Efficient asset management is crucial in Industry 4.0, and the paper emphasizes the need for predictive maintenance to prevent unexpected breakdowns and ensure optimal asset performance. By leveraging IoT devices and sensors, real-time data is collected from assets and processed using fog computing, a decentralized approach at the network edge.Machine learning algorithms are applied to the collected data, enabling the detection of patterns, anomalies, and potential performance issues. This proactive approach facilitates timely maintenance actions, avoiding costly asset failures.The paper provides a comprehensive methodology that covers data collection, feature extraction, feature selection, and the implementation of machine learning algorithms for predictive maintenance. It addresses challenges related to data quality, scalability, and security in deploying the model.The effectiveness of the proposed model is validated through a detailed case study, demonstrating accurate predictions of asset failures and enabling timely maintenance interventions.The paper highlights the potential of combining IoT, fog computing, and machine learning in asset management for Industry 4.0. The predictive maintenance model presented offers a proactive approach to enhance asset reliability, and the methodology and case study findings provide valuable insights for practical implementation in industrial settings[2].

The research paper ”Communication-Efficient Federated Edge Learning for NR-U-Based IIoT Networks” presents an innovative approach to federated edge learning in Industrial Internet of Things (IIoT) networks using NR-U technology. The authors tackle the challenge of communication efficiency by introducing a federated learning framework that allows edge devices to collaborate in model training while minimizing communication overhead. They leverage the decentralized nature of federated learning, where edge devices train local models using their own data and periodically aggregate updates to create a global model. To further enhance communication efficiency, a compression algorithm is proposed to reduce the size of model updates transmitted over the network, making it suitable for resource-constrained IIoT environments.The effectiveness of the proposed framework is validated through simulations and experiments that consider various IIoT scenarios. The results demonstrate the capability of the communication-efficient federated edge learning approach to significantly reduce communication overhead while maintaining high model accuracy. By minimizing bandwidth requirements and communication latency, this approach offers a practical solution for efficient model training in IIoT networks.In conclusion, the paper emphasizes the importance of communication efficiency in NR-U-based IIoT networks and introduces a federated edge learning framework as a promising solution. The compression algorithm and collaborative model training approach contribute to mitigating communication challenges in resource-constrained environments. The research findings provide valuable insights for implementing federated edge learning, enhancing the efficiency and effectiveness of machine learning applications in industrial settings[3].

IIoT-based Motion Control Efficiency in Automated Warehouses defines IoT as a technology development process that enables the interconnection of everyday objects through the internet network. It highlights the key characteristics of IoT, including pervasive sensing, cloud connectivity, and the delivery of software services and data analytics. The Industrial Internet of Things (IIoT) is introduced as an extension of IoT, specifically focusing on the industrial context and addressing requirements such as determinism, real-time capability, robustness, reliability, security, and integrity.The paper discusses the convergence of IoT and IIoT concepts in the Industry 4.0 project, which originated in Germany. Industry 4.0 aims to improve industrial processes by integrating advancements in software and communication technology. It presents the idea of reducing costs and enhancing efficiency through the application of IoT and IIoT principles in industrial control systems.The subsequent sections of the paper provide practical examples to illustrate the implementation of IoT and IIoT in industrial applications. One example is a Gantry architecture used for a Pick-and-Place robot, showcasing how IoT and IIoT technologies can enhance automation and improve operational efficiency. Another example focuses on stacker cranes in an automated warehouse, demonstrating how IoT and IIoT can optimize warehouse operations and increase productivity. The paper also introduces macros based on the EtherCAT protocol, which suggest strategies for improving energy efficiency in industrial processes.The paper provides an introduction to IoT and IIoT, emphasizing their relevance and specific requirements in the industrial context. It highlights the Industry 4.0 project as an exemplar of IoT and IIoT implementation in industrial processes. The practical examples presented illustrate the potential benefits of IoT and IIoT technologies in industrial applications, offering insights into how these technologies can enhance automation, optimize operations, and improve energy efficiency[4].

### 2.2.2 Angular

An extensively utilized platform for building web and mobile applications is Angular. The paper commences by presenting the Angular framework and delving into its remarkable features and advantages. They provide an explanation of the constituting elements of an Angular application, namely, modules, components, services, and directives. Subsequently, the article presents a comprehensive evaluation of the Angular structure, which encompasses the hierarchy of components, the detection of changes, and the injection of dependencies. The manner in which the architecture components function and combine to form a potent and adaptable application development platform is explicated by the writers. In addition, the writers conduct a thorough examination of different Angular aspects like templates, data connection, pipes, and directives. The roles and functions of each feature are explained and illustrated with code snippets and examples. Angular testing underscores the crucial nature of verifying code and the high utility of Karma and Jasmine as testing tools. Ultimately, the paper's conclusion restates the main ideas and underscores the benefits of employing the Angular framework for the development of both web and mobile applications. In essence, the article delivers an extensive and detailed examination of the Angular framework, concentrating primarily on its structure and crucial aspects. The paper's coherence is greatly aided by the authors' inclusion of practical examples and code snippets, which effectively conveys applicable wisdom to developers and researchers concerning the capacities and operations of the Angular framework. The contents of the paper hold value for individuals involved in web and mobile application development[5].

Creating a way for people and machines to communicate on the internet for controlling factories using a program called Angular. The writers talk about why web-based HMIs are better than traditional HMIs. They are easier to get to, work on any device, and can handle bigger projects. They mention that more and more factories are using computer screens to control their machines. The writers explain about Angular, a famous free web tool to make one-page apps. They explain what it can do and why it's useful, like being able to make code that can be used over and over again, and how it allows for reactive programming. The writers explain how their online control panel works. It has two parts: an Angular program on the user's computer and a Node.js program on the server. They clarify how a computer program on your device talks to the machine controller through a RESTful software, and how the program on the server verifies who you are and stores data. The writers talk about different parts of an Angular app. The main part is where you start the app and see the menu. The dashboard part shows information from a machine in real-time. They show examples of how to use these parts of the program by giving code samples. At last, the writers show what they found out about the web-based HMI system. They asked industrial control engineers to test the system and they said it was easy to use and worked well. The writers say that their computer system for controlling machines at work is helpful and easy to use. It can work for many different situations. The paper explains how a web-based system called Angular is used for industrial automation. It discusses the benefits of using this system and provides a lot of information about it. The people who wrote about the system say that it works well and can be used in many other places too[6].

### 2.2.3 Cross Platform App Development

The paper From Native to Cross-platform Hybrid Development presents a comparison between native and cross-platform hybrid mobile app development, highlighting the advantages and disadvantages of each approach. The authors begin by defining the two development approaches and discussing the differences between them. They then delve into the various factors that developers should consider when choosing between the two approaches. The authors provide a literature review of previous studies on the topic of native versus cross-platform hybrid development, summarizing the findings of each study. They highlight the importance of performance, user experience, development time and cost, platform fragmentation, and tool support as key factors to consider when choosing between native and cross-platform hybrid development. The authors also discuss the various tools and frameworks available for cross-platform hybrid development, such as Apache Cordova, React Native, and Xamarin. They compare the features and capabilities of these tools, as well as their performance and ease of use. In addition, the authors discuss the challenges of cross-platform hybrid development, such as issues with debugging, platform-specific features, and hardware limitations. They provide recommendations for how developers can overcome these challenges. Overall, the authors conclude that while both native and cross-platform hybrid development approaches have their advantages and disadvantages, the choice ultimately depends on the specific needs of the project and the resources available to the development team. The paper provides a useful overview of the topic, synthesizing information from previous studies and providing practical recommendations for developers[7].

### 2.2.4 FastAPI

The technical guide ”Getting Started with FastAPI” offers developers a comprehensive resource to familiarize themselves with FastAPI, a Python framework designed specifically for web API development. This guide provides a step-by-step walkthrough, explaining the framework’s architecture, features, and the process of building a basic API from scratch. It begins by introducing FastAPI, highlighting its key characteristics such as excellent performance, support for type annotations, automatic API documentation, and integration with modern Python standards like async/await. The guide covers essential concepts related to HTTP and RESTful APIs before diving into the core principles of FastAPI. Topics covered include defining endpoints, creating data models, handling requests and responses, managing errors, and implementing authentication. Practical code snippets and examples are provided throughout the guide to facilitate understanding and help developers get started with FastAPI. Overall, ”Getting Started with FastAPI” is a comprehensive and well-structured guide that provides developers with a solid foundation for quickly and efficiently building high-performance web APIs using FastAPI.[8].

### 2.2.5 NoSQL Database

The research paper Security Analysis of Unstructured Data in NoSQL MongoDB Database focuses on the security aspects of unstructured data stored in MongoDB, which is a popular NoSQL database management system. The authors aim to identify potential vulnerabilities and security risks associated with MongoDB’s handling of unstructured data.The paper begins by providing an overview of MongoDB and the unique characteristics of unstructured data stored in this database. It highlights the importance of securing sensitive information and the potential risks that can arise from inadequate security measures.The authors then proceed to conduct a security analysis of MongoDB, examining various aspects such as authentication mechanisms, access control, encryption, and auditing. They explore common security vulnerabilities and weaknesses that can be exploited by attackers, including injection attacks, insecure defaults, and privilege escalation.In addition to identifying vulnerabilities, the paper also proposes security recommendations and best practices to mitigate the identified risks. It emphasizes the importance of implementing strong authentication and authorization mechanisms, employing encryption for data protection, and regularly auditing the database to detect any suspicious activities.The paper provides valuable insights into the security considerations of unstructured data in MongoDB. It serves as a guide for administrators and developers to understand and address the potential security risks associated with storing and managing unstructured data in a NoSQL database environment[9].

This study compares how well MongoDB and MySQL work for managing IoT data in different clouds. They want to see which one is better. The writers test how well these databases work by looking at how fast they answer questions, how much work they can handle, and how easy it is to make them bigger. Usually, MongoDB works better than MySQL for programs that need to handle a lot of data quickly. This is because MongoDB can work with lots of unorganized data as it uses a document-based model. This paper looks at how well MongoDB and MySQL work for saving and getting sensor information in an IoT setup. The research showed that MongoDB was better than MySQL at finding information quickly and processing a lot of data at once. This research compares how well MongoDB and MySQL databases can keep and get social media information. The research showed that MongoDB was better than MySQL when it came to finding data quickly and being able to handle lots of data. The writers of the article test how well MongoDB and MySQL databases work for managing information from the Internet of Things (IoT) in different online places like Amazon Web Services, Microsoft Azure, and Google Cloud Platform. The writers did some tests to see how fast the databases responded to requests, how much they could handle at once, and how well they could handle larger amounts of data. The experiments found that when managing IoT data in three different cloud environments, MongoDB is faster and can handle more queries than MySQL. MongoDB works better than MySQL on AWS and Azure, but not on GCP when it comes to scaling up. Basically, when it comes to apps that need to process lots of data quickly, MongoDB is better than MySQL according to what experts have written. This study shows that these databases work differently in various cloud setups. The research made a pretend stream of information from IoT devices. They saved the information in two different databases, MongoDB and MySQL. We checked how well each database worked by asking it to do a specific set of tasks. The findings showed that MongoDB was better than MySQL in speed and efficiency for answering queries in all three cloud settings. This means that MongoDB had quicker response times and could handle more queries at a time compared to MySQL. In AWS and Azure, MongoDB is more scalable than MySQL, but not in GCP. The writers think that

MongoDB's way of storing data, which is like a bunch of documents, is better for managing messy IoT data. They said that the way MongoDB is designed to group and analyze data is very effective and useful. This paper shows that MongoDB is better than MySQL for managing data in the internet of things (IoT) in the cloud. MongoDB is faster and can handle more data, which is important when processing and analyzing data in real-time for IoT applications[10].

### 2.2.6 Redis

The research paper titled "A Comparative Study of Relational Database and Key-Value Database for Big Data Applications" provides a detailed analysis and comparison of relational databases and key-value databases in the context of big data applications.The paper highlights the increasing need for effective data management solutions in the era of big data, where large volumes of structured and unstructured data are generated and processed. Relational databases have been widely used for traditional data storage and management, while key-value databases have gained popularity due to their ability to handle high data throughput and scalability.The authors present a comprehensive evaluation of both database types based on various criteria, including data modeling, query performance, scalability, fault tolerance, data consistency, and ease of use. They conduct experiments and benchmarks to assess the performance and capabilities of each database type in handling big data workloads.The results of the comparative study provide insights into the strengths and limitations of relational databases and key-value databases in big data applications. The authors discuss the trade-offs between data consistency and scalability, query performance, and data modeling flexibility. They also address the challenges and considerations when choosing between the two database types based on specific application requirements.The paper contributes to the understanding of selecting the appropriate database technology for big data applications. It provides valuable insights into the characteristics, performance, and suitability of relational databases and key-value databases in managing and processing large-scale datasets[11].

Redis is a tool that helps organizations quickly and easily access large sets of data. It is free to use, and many businesses find it useful for their needs. Redis is really helpful because it is fast and doesn't make you wait long. But sometimes, it can lose information because of things like computer problems or broken hardware. To solve a problem, a paper called "A data recovery technique for Redis using internal dictionary structure" came up with a new way to get back data by using Redis's internal dictionary structure. To get back lost information, we look at a book of words and use the information inside to find it again. The text talks about Redis, a type of storage tool that uses a special way of organizing information called a dictionary. This dictionary organizes information into key-value pairs. The dictionary is like a filing system where each word has a label (key) and a definition (value). The writers want to say that the dictionary is very important for Redis to work properly. If something goes wrong with the dictionary, it can lead to data loss. After that, the paper explains how to recover data using the suggested method. This way includes looking through a book of words and finding missing information by using the words and their meanings saved in it. The writers say that this method works well because the dictionary has everything needed to bring back the data, like important information and details. To test how well the new method works, the writers did some tests in a pretend Redis place. The tests show that the method can get back lost information very well and without using too much extra resources, even when a lot of data is missing. The paper comes up with a new way to get back lost data in Redis by using the dictionary structure inside. This tool is useful for companies that use Redis to store data because it is easy to use and works well[12].

### 2.2.7 Python

The programming language Python has gained popularity for its flexibility, ease-of-use, and comprehensibility. Thanks to its expansive set of pre-existing tools, robust support from developers worldwide, and ability to be applied across varied disciplines, Python has become a top choice for tasks ranging from data analysis and website creation to advanced science and AI development. In addition, the writers deliberate on a few advantages of Python in comparison to other coding languages, such as its uncomplicated acquisition, compatibility with any operating system, and adaptability. Python code samples are offered for a variety of assignments, including but not limited to data display, web extraction, and machine education. According to the authors' analysis, Python exemplifies the upcoming era of programming languages, and its widespread adoption is likely to soar due to its user-friendly nature and aptitude for adeptly managing complicated functions. It is proposed that acquiring Python skills is crucial for individuals in the technology sector, regardless of whether they are students or professionals, owing to the various prospects it offers. In summary, this article provides a succinct and understandable summary of the characteristics and uses of Python, convincingly demonstrating why it is regarded as the programming language that will lead the way in the future. The provided content features samples of code that cater to individuals with varying levels of programming expertise, from novices to professionals[13].

Internet of Things (IoT) technology is used to monitor smart environments, especially using the Python programming language. The research paper titled ”A Survey: How Python Pitches in IT-World” presents a comprehensive survey on the usage and impact of the Python programming language in the IT industry. Python has gained significant popularity in recent years due to its simplicity, versatility, and extensive range of libraries and frameworks.The paper begins by discussing the reasons behind Python's widespread adoption, including its clean syntax, ease of learning, and extensive community support. It highlights the various domains in which Python is commonly used, such as web development, data science, machine learning, and automation.The authors conduct a survey to gather insights from professionals working in the IT industry about their experiences with Python. The survey covers topics such as the reasons for choosing Python, the most popular libraries and frameworks, and the perceived advantages and disadvantages of using Python in their projects.The survey results provide valuable insights into the current state of Python usage in the IT industry. They highlight the dominance of Python in data-related fields, with libraries like NumPy, Pandas, and TensorFlow being widely favored. The survey also reveals Python's strengths in terms of code readability, productivity, and community support.Additionally, the paper discusses the challenges faced by Python users, including performance limitations and the lack of strong typing. It also explores the future prospects of Python, such as the adoption of Python 3 and the emerging trends in the Python ecosystem.The paper offers a comprehensive overview of Python's role in the IT world through a survey-based approach. It provides valuable insights into the reasons for Python's popularity, its applications in various domains, and the experiences of professionals using Python. The findings of this survey can serve as a reference for individuals and organizations considering the adoption of Python in their IT projects.[14].

### 2.2.8 Difference between MongoDB and PostgreSQL

The contrast in functionality of MongoDB and PostgreSQL. By analyzing the performance characteristics of both databases, the authors investigate their appropriateness for diverse applications across different workloads. The article serves as an introduction to the various categories of NoSQL databases. Subsequently, it provides a summary of the distinctive aspects of MongoDB and PostgreSQL, examining the benefits and drawbacks of utilizing both. The writers also provide a concise account of the approach utilized to carry out the assessments of performance. The scholars proceed to delve into an analysis of their assessment findings. The experiments were conducted using three distinct levels of task demands: those that emphasized reading, those that focused on writing, and those that involved a combination of both. According to the study, MongoDB demonstrated superior performance in situations where there were more read operations, but PostgreSQL outshone MongoDB in instances where there were greater numbers of write operations. Yet, when faced with a combination of workloads, the disparity in performance between the two databases was negligible. The article also evaluates how distinct set-ups affect the efficiency of each database. The study concluded that adjusting specific factors such as buffer capacities, connection quantities, and indices could considerably enhance the efficiency of both databases. In their report, the writers provide a condensed version of their discoveries and offer suggestions on selecting either MongoDB or PostgreSQL depending on the specific demands of the application. According to them, MongoDB is a suitable option for applications that prioritize quick read access and the ability to expand easily. On the other hand, PostgreSQL is better suited for applications that necessitate compliance with ACID principles, advanced querying capabilities, and support for intricate data types. In general, the article offers a valuable assessment of the strengths and weaknesses of MongoDB and PostgreSQL, presenting a useful comparison between the two. It should be highlighted that the performance of the two databases can be subject to variation depending on the unique application scenario and the hardware and software setup employed[15].

# Chapter 3

# Methodology

**IOT MANAGER - EDGE MANAGEMENT** is a platform that allows users to access information about their products and equipment's statistics and analyses. This is a platform that efficiently manages data coming from different IoT devices in an industry. The IoT Manager-Edge Management platform offers a flexible environment for users to create customised rules and alarms tailored to their specific requirements. By setting up rules, users can calculate and store new process parameters, enabling better decision-making for production, maintenance, and management teams. Additionally, the platform supports the creation of virtual parameters, reducing the need for additional equipment and resulting in significant cost savings.

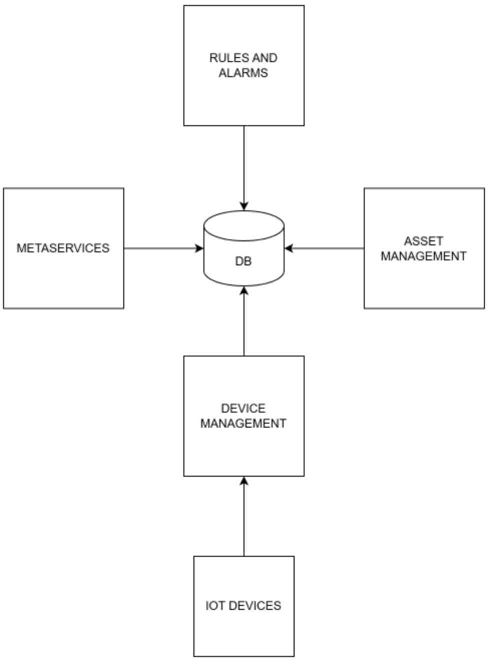


Figure 3.1: IoT Manager System

The alarm system within the platform promptly notifies managers of any irregular conditions or issues with plant equipment, allowing them to take corrective measures and restore normal operation. This leads to improved efficiency, increased production, and effective equipment management. The rule functions feature enables users to create custom code snippets that can be utilised in rule setup, providing further flexibility and customization options. Furthermore, the rule template feature streamlines the process of bulk rule creation and upload, enhancing efficiency for large-scale deployments.

Additionally, the super admin can control user roles and assign custom views to each user in the system.The device management module offers a comprehensive overview of on-site devices, gathering real-time data through heart-beat messages. By analysing the last sync data, the platform determines the online or offline status of each device. The system stores heart-beat messages in MongoDB and identifies devices as offline if they fail to transmit data within a specified time frame.

Access to the platform is regulated through user privileges and roles. Super administrators are responsible for authorising user access, ensuring that only authorised individuals can log into the system. The Asset Management module simplifies the configuration of assets and their corresponding parameters, covering all equipment used throughout the project. Users can easily create and assign parameters and units specific to each piece of equipment. Additionally, the platform features asset modelling capabilities, promoting reusability by allowing users to create asset models once, even in scenarios with multiple plants. The IoT Manager provides users with a comprehensive platform to manage their devices, access product statistics, and receive reports. IoT Manager enriches all phases of the industrial lifecycle, including machines, maintenance, production, and more.

## 3.1 Key Features of IoT Manager-Edge Management

- Basic rule creation setup.
- Management of created rules.
    1. Listing of rules.
    2. Filtering of created rules.
    3. Deletion, Updating, Copying of rules.
- Execution type:
    1. Real time Execution.
    2. Scheduled Execution.

- Alarm Setup:
  1. Create new Alarms.
  2. Setting Rules for alarm execution.
  3. Create, update, delete, and copy ability.
- Rule function.
- Rule template.

## 3.2 Module Description

### 3.2.1 Rule Setup

The rule and alarm setup developed for the platform is a crucial component, providing users the calculations and alerts according to their needs. Setting up rules helps to calculate and store new process parameters, which helps the production, maintenance, or management team understand and make the right decisions. Creating rules also helps to calculate virtual parameters, reducing the number of equipment required to make the measurement, which helps in reducing the total cost drastically.

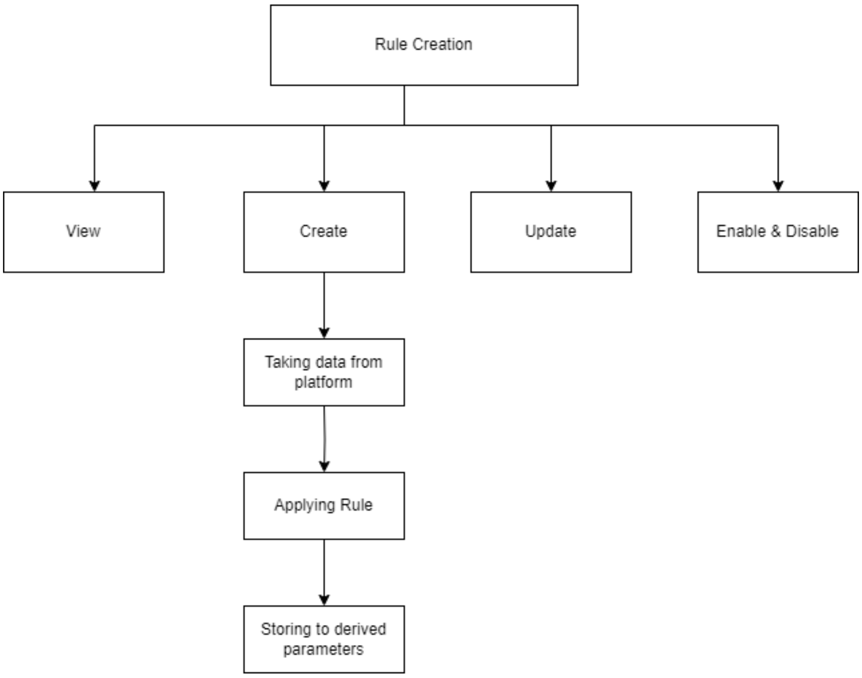


Figure 3.1: rule setup

Rules created by the user are saved in the database. Users can view all the rules created. They can copy,edit and delete these rules. Users can select the hierarchy to which the rule is to be applied. He can select the execution type of the rule as real time or scheduled. In the scheduled rule he can specify the time and repetition of the rule. Schedule itself is of three types,One Time scheduling type creates a rule that executes and disables after running once. The user must set a date and time at which the rule must initiate. The Recurring schedule type repeats after the set time or day. Set the occurrence to take place by entering the minute, hour, shift, day of the week, day of the month, week and month at which the scheduled rule should execute. Recurring(Kairos) Schedule, Historical data based aggregations can be scheduled to take place using the aggregations option.

### 3.2.2 Alarm Setup

This module is only available to create an alarm which is to be triggered when the specified situation occurs. Alarm systems signal to the managers the irregular conditions and problems of the plant and equipment, allowing them to take corrective measures and restore the plant/equipment to normal conditions. This helps in effective running, increased production, and efficiency of the equipment.

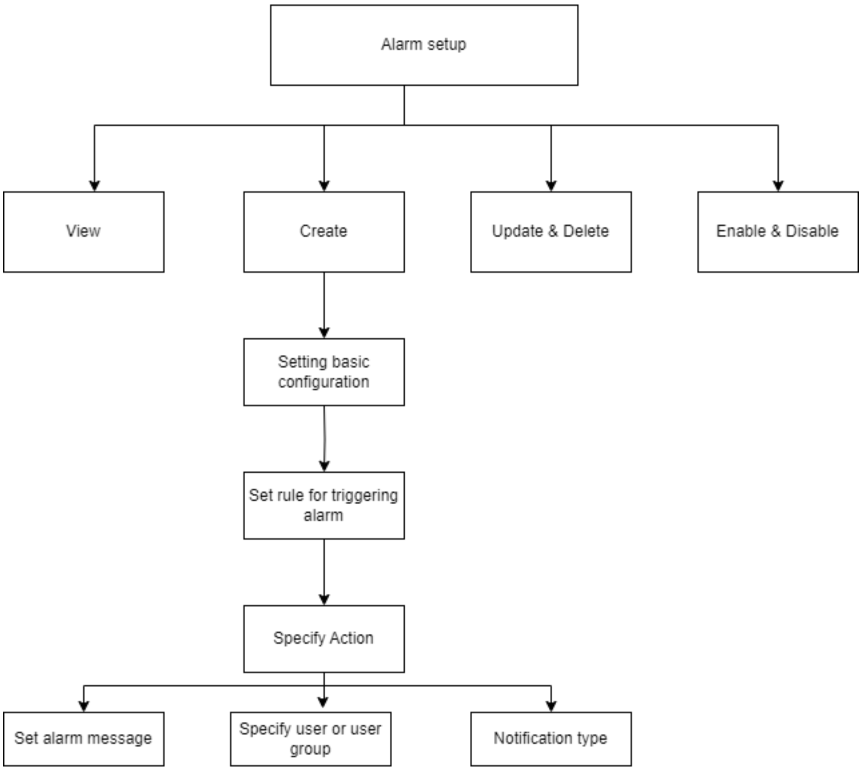


Figure 3.2: alarm setup

In this module the user can view all the rules created. They can copy,edit and delete these rules.Users can select the hierarchy to which the alarm is to be applied. They can set the conditions for triggering the rule in the set rule option and specify the action in the action to take field.

### 3.2.3 Rule function

Rule functions allow the user to write a custom piece of code that can be later used in setting up the rule. We can write the program logic which can be called later in the rule setup module. We can call the written logic just like a function call in python. This makes the rule creation much easier by avoiding the repetition of the same logic multiple times. In this module, we can view and edit the functions we created. There is also an option to upload the written function to the global catalogue to use in other projects too. In the create new option, we can specify the function name and write the program logic there.

### 3.2.4 Rule templates

The rule template feature streamlines the process of bulk rule creation and upload, enhancing efficiency for large-scale deployments. Instead of writing the same kind of rule many times, we can write the rules in some variables and can map the parameters to this rule. Here we can specify the names and basic things in the basic configuration field. In the conditions field we can write our rule and in rule template option we can map our needed parameters.

## 3.3 System Specifications

The software and hardware specifications recognized for the system on the basis of their requirements are specified in this section.

### 3.3.1 Hardware Requirements

- Processor: Minimum 1 GHz (Recommended 2GHz or more)
- Hard Drive: Minimum 4 MB (Recommended 6 GB or more)
- Memory (RAM): Minimum 1 GB (Recommended 4 GB or above)

- Internet connection

### 3.3.2 Software Requirements

- Angular JS - Front End
- Fast API Python - Back End
- Web Server - Apache or Nginx
- Mongo, PostgreSQL, Redis - Database
- Windows, Mac, Linux, Any - OS
- Mozilla Firefox, Microsoft Edge, Any - Browser

### 3.3.3 Software Description

- Angular: Angular is an open-source framework for developing web-based applications that is based on TypeScript. It is currently one of the most widely used UI frameworks. Angular makes it easy to create faster web applications and is a platform that simplifies the process of creating web applications. Angular provides a powerful and straightforward template syntax that allows for the rapid generation of UI views. The key features of Angular include its component-based structure, use of TypeScript, and the ability to create services that can be used across multiple applications.

- Python: Python is a high-level, object-oriented programming language with an interactive, interpreted design that is widely used for general-purpose programming. It allows developers to express complex concepts in just a few lines of code and has a vast library and an extensive community of supporters. Additionally, Python runs on various operating systems, including Windows, Linux, and macOS. Guido van Rossum created Python in the late 1980s as a replacement for the ABC programming language. It was initially released as Python 0.9. In 1991. Python 2.0 introduced new features such as cycle-detecting garbage collection, list comprehensions, reference counting, and support for Unicode in 2000. Python 3.0, released in 2008, was a significant update that was not entirely backward compatible with previous versions. Python 2 was abandoned in

2020 with the release of version 2.7.18. Python is a great choice for developers due to its compatibility, readability, maintainability, interactive nature, and robust standard library.

- MongoDB: A flexible and scalable NoSQL database system known for its versatility, MongoDB manages document-oriented information. It is widely used by high-profile businesses due to its several features such as flexible schema design, load balancing, and horizontal scalability. Unlike relational databases, NoSQL databases store data schemaless, in multiple collections and nodes, and are scaled horizontally, supporting limited join queries. MongoDB offers support for multiple programming languages, including C, C++, C#, Go, Java, Python, Ruby, and Swift. Python is a great choice for developers and is used with MongoDB due to its compatibility, readability, maintainability, interactive nature, and robust standard library. MongoDB can also be used as a file storage system, known as GridFS, and provides different ways to perform aggregation operations.

- PostgreSQL: PostgreSQL is a robust object-relational database system that merges SQL language with various abilities to store and scale data efficiently. Its development has spanned over 30 years, and it was initially part of the POSTGRES project at the University of California, Berkeley. PostgreSQL is famous for its reliability, data integrity, and wide range of features, making it a dependable choice for developers. The open-source community behind PostgreSQL is devoted to providing high-performing and innovative solutions, solidifying its reputation. Moreover, PostgreSQL has been ACID-compliant since 2001 and is compatible with all major operating systems.

- FastAPI: FastAPI is a Python-based web framework that enables developers to create APIs quickly and efficiently. It is designed to be user-friendly and provide high performance. FastAPI uses modern Python features, such as type hints and async programming, to help developers write high-performance code. It also includes built-in support for popular databases such as MongoDB. Additionally, it offers tools for data validation, serialization, and documentation. FastAPI is lightweight and easy to learn, making it a popular choice for developers who want to build fast and scalable APIs.

- Redis DB: Redis is a popular open-source in-memory data structure store that serves as a versatile database, cache, and message broker. It offers support for various data structures, including strings, hashes, lists, sets, and sorted sets. Redis is renowned for its impressive speed and its ability to handle vast amounts of data. Besides, it comes with several built-in features such as replication, transactions, Lua scripting, and pub/sub messaging. Redis is widely used in web applications, message queuing systems, and real-time analytics. It also provides client libraries for different programming languages, including Python.

## 3.4 System Design

The system design phase effectively bridges the gap between the issue area and the current system, addressing the solution area - specifically, ”how to implement?” During this stage, the SRS documentation is converted into an effective implementation format that also outlines the system's operation. The complex task of system development is broken down into manageable sub-activities that work together to achieve the ultimate goal of system development. A good design enables the production of efficient code and minimizes implementation size based on the application and project requirements.

System design comprises two levels: logical design and physical design. Logical design provides an abstract illustration of the system's inputs, outputs, and data flow, meeting user needs in describing inputs (sources), outputs (destinations), databases (data storage), and processes (data flows). Logical design is crucial for the successful implementation of a corporate database. An inadequate logical design may require costly modifications to data collection, storage, and security later on. A sound preliminary design simplifies database development and evaluation, contributing to successful execution. The system analyst specifies user requirements in detail, essentially dictating the information flow into and out of the system and the necessary data sources during logical system design.

When developing a system's logical design, the system analyst specifies user needs with enough detail to determine how information enters and leaves the system and the required data sources. Diagrams of data flow and E-R diagram modeling are used. Additionally, the input/output media is specified, the database is designed, and backup procedures are established. Finally, system implementation is planned.

### 3.4.1 System Architecture

The proposed architecture for the IoT Manager platform is a web-based client-server architecture, where the server is responsible for managing the devices and data storage, while the client provides the user interface for monitoring and managing the IoT devices. The server side includes a database management system and a web server that receives data from the devices and sends it to the client via APIs. The client side includes a web application that can be accessed via any modern web browser.

# Chapter 4

# Result and Discussion

The implementation of the **IOT MANAGER - EDGE MANAGEMENT** platform provides significant benefits for industrial data management and monitoring. The platform offers features such as rule setup, alarm systems, rule functions, and rule templates, enabling users to customise and automate data processing and decision-making. By setting up rules, users can calculate and store new process parameters, leading to better understanding and informed decision-making for production, maintenance, and management teams.The alarm systems in IoT Manager play a crucial role in notifying managers of irregular conditions and issues with plant equipment. These timely alerts allow for corrective actions, leading to effective plant operation, increased production, and improved equipment efficiency. The device management module of IoT Manager provides a comprehensive overview of deployed devices, capturing heart-beat messages for real-time data analysis and the Asset Management module of IoT Manager simplifies the configuration of assets and their corresponding parameters, covering all equipment used throughout the project.

Overall, the implementation of IoT Manager-Edge Management demonstrates its effectiveness in industrial data management, monitoring, and decision-making. The platform's features enable users to create customised rules, set up alarm systems, analyse real-time data, and manage assets efficiently. The discussed functionalities contribute to improved productivity, reduced costs, increased uptime, enhanced quality control, and better business development. The platform's benefits extend to data security, privacy, and compliance with regulatory guidelines, ensuring reliable and accurate data for informed decision-making.

## 4.1 Testing Methods

Testing ensures that the system is error-free based on criteria that are anticipated by the user or by the organization. A system may have high-end or low-end performance based on the environment in which it operates.

### 4.1.1 Functionality Testing

These tests check if the part of the system that is supposed to do something actually works well or not. The QA team makes some tests based on what needs to be checked, and then they test them out. QA team tests the functionalities according to the requirements of the product.

- Login Functionality: This test verifies that users can log in using both Google and custom login methods. Also test the forgot password and reset password functionality for custom login users. Reset functionality sends a mail to the registered email account. Using the link provided in the mail the user can reset their password. These needs to be tested.

- Role-Based Access Control: This test verifies that users are provided access to the platform based on their assigned roles and privileges. It should also test that custom roles can be created and that super admins can create, view, and update users and custom roles.

- Session Management: This test verifies that users are automatically logged out of the system after 48 hours of inactivity. It should also test that users who try to access the system after being logged out are redirected to the login page.

- Data Security: This test verifies that only authorized users have access to the platform and that user data is secured. It also tests that the system prevents unauthorized access attempts and that user data is encrypted during storage.

- Error Handling: This test verifies that the system provides appropriate error messages for various scenarios, such as incorrect login credentials or attempting to access restricted features. It should also test that the system logs errors for debugging purposes.

### 4.1.2 Unit Testing

In this project, unit testing is an important aspect of validation testing, aimed at identifying defects in individual sections of the project. Unit testing is used to evaluate the functionality and performance of each system unit or component in isolation. This testing helps developers to identify and resolve issues early on, thereby minimizing the risk of encountering problems during deployment or integration. A successful validation test confirms that the system meets the requirements, while a failed test indicates that modifications are necessary. Unit testing is a critical step in the validation process, enabling developers to ensure that the system performs as expected and meets the needs of all stakeholders.

The Real-time alert is tested by checking whether the specified user is notified when any situation mentioned is occurred. Rule setup is tested by creating a sample rule of adding two parameters and assigning new value into a new parameter

The portal is tested against multiple test cases during validation testing. Logging in to the system is one of the important part of the system. valid credentials needs to given in order to access the system. password is matched against a regex structure which must have 8 alphanumeric characters. Both the data is tested and validated using the data available in the database. After it is validated the user is given access based on the user role which also is validated from the database. For the google login an id token is generated during the sign-in which is then used for getting google user details. Then the generated data is used for validation with the database information.

### 4.1.3 User Acceptance Testing

The success of any system depends largely on user acceptance. To ensure this, the system must undergo continuous evaluation and testing throughout the development phase. This entails maintaining open communication with potential end-users and incorporating their feedback into the system's design. In this project, a menu-driven system, input screen design, and output screen design were carefully considered and implemented to achieve user approval. User-centered design is the process of involving users in the design and development of the system, ensuring that their needs and preferences are met. This leads to higher levels of user satisfaction and system adoption.

Validate the user interface of IoT Manager to ensure it is user-friendly, visually appealing, and responsive across different devices and browsers. Verify that all UI elements are displayed correctly, and users can easily interact with them. UI is created based on the users that will be accessing the system. On each iterative development, users are involved and with their constant feedback and criticism the UI is developed and deployed.

Test Scenarios:

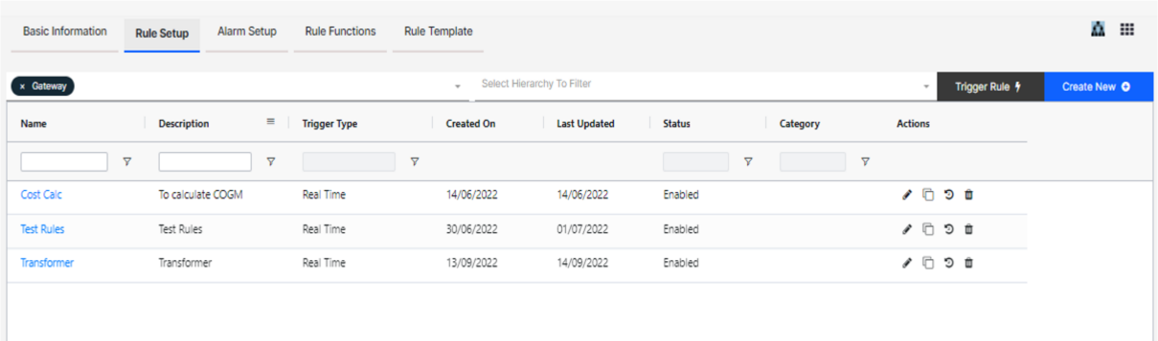
- Login to the IoT Manager platform with valid credentials. Navigate to the heart-beat data section of the platform. Verify that the heart-beat data for all my IoT devices is displayed correctly, including the device name, software name, MAC address, and last sync time converted to my local time zone.

- Select one of my devices and verify that I can view detailed information about the device, including its status (online/offline) and any alerts or notifications related to the device.
- Created an alarm by specifying a scenario and assigned the user to notified as me.
- Verify that I receive a notification, either by email or through the platform in alert system
- Verify that the rule function is correctly working by creating a rule function and calling it in a rule creation step
- Verify that the rule template is correctly working by creating a template and mapping multiple parameters into it

## 4.2 Output Screens and Results

1. Rule Setup

   This is the rule setup page in which we can view all the rule which we are created. There is an option to update and delete the created rules. If we click on create rule button, the window for new rule creation will appear. we can also filter the rules.



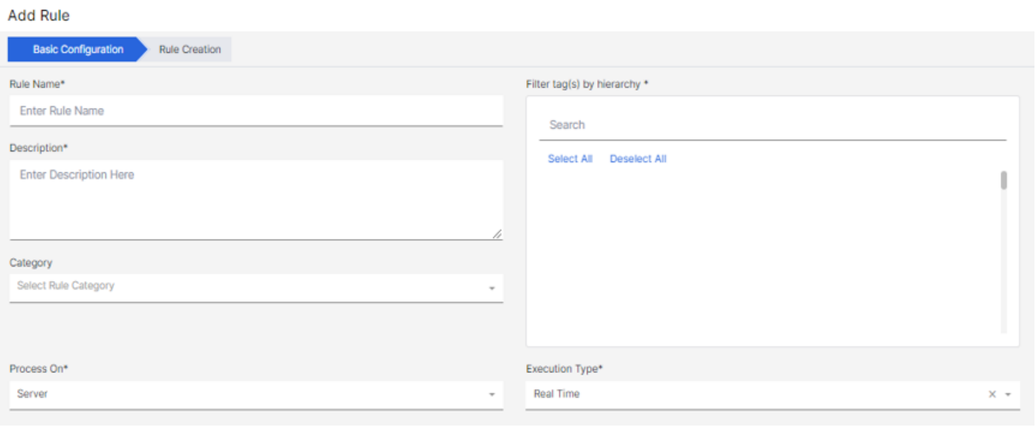
| Name | Description | Trigger Type | Created On | Last Updated | Status | Category | Actions |
|---|---|---|---|---|---|---|---|
| Cost Calc | To calculate COGM | Real Time | 14/06/2022 | 14/06/2022 | Enabled | | |
| Test Rules | Test Rules | Real Time | 30/06/2022 | 01/07/2022 | Enabled | | |
| Transformer | Transformer | Real Time | 13/09/2022 | 14/09/2022 | Enabled | | |

Figure 4.1: rule setup page

2. Basic configuration

   In this page we can provide the basic details of the rule. we can set the rule name, description, execution type etc... Execution type is of two types, Scheduled and Recurrent. In scheduled rule, we can specify the time interval when the corresponding rule is to be triggered. We can also select the hierarchy in which the rule is to be applied.

   Rule Basic Configuration.



Add Rule

Basic Configuration | Rule Creation

Rule Name*: Enter Rule Name

Description*: Enter Description Here

Category: Select Rule Category

Process On*: Server

Filter tag(s) by hierarchy *: Search

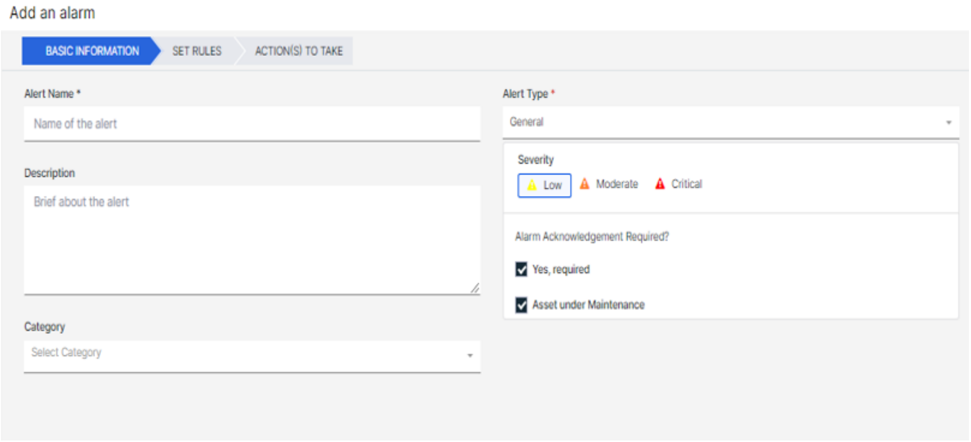
Select All Deselect All

Execution Type*: Real Time

Figure 4.2: Basic configuration

3. Alarm Basic Configuration

   A page for setting basic configuration. Here we can set the alarm name, description,category etc... Here we can select the severity and hierarchy of alarm to be applied.



Add an alarm

BASIC INFORMATION | SET RULES | ACTION(S) TO TAKE

Alert Name *: Name of the alert

Description: Brief about the alert

Category: Select Category

Alert Type *: General

Severity: Low | Moderate | Critical

Alarm Acknowledgement Required?

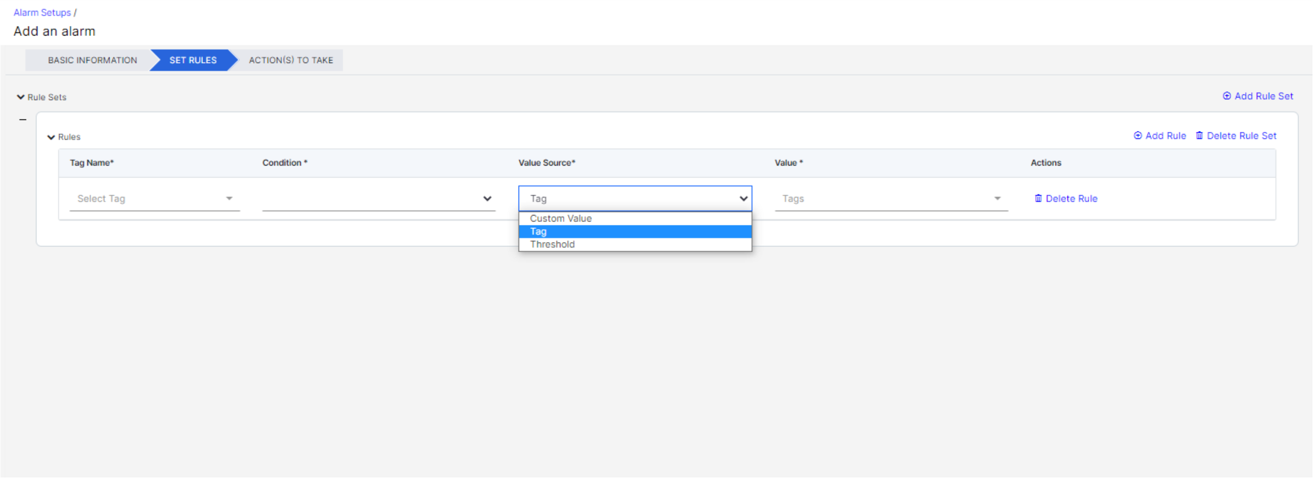
☑ Yes, required

☑ Asset under Maintenance

Figure 4.3: Basic configuration of alarm

4. Set Rule

A page for setting rule for alarm. Here we can give the condition for triggering the alarm. In first column we can select the tag name after that we can give the condition and the value to be compared. This can be a custom value or we can compare the value in another tag too. We can add multiple rules in one section by clicking add rule set button.



Alarm Setups /

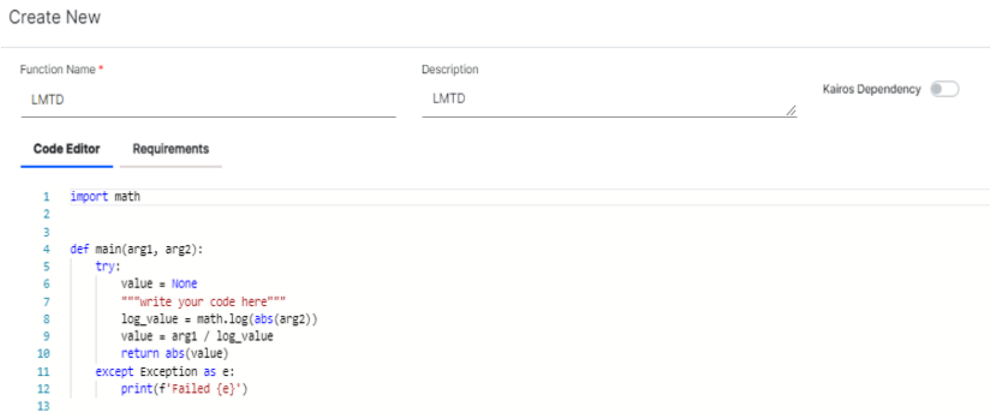
Add an alarm

| Tag Name* | Condition * | Value Source* | Value * | Actions |
|---|---|---|---|---|
| Select Tag |  | Tag | Tags | Delete Rule |

Figure 4.4: Rule setup for alarm

5. Rule function

A page for writing the function logic. Here we can specify the function name and description. In the text area below, we can write our program logic.



Create New

Function Name *: LMTD

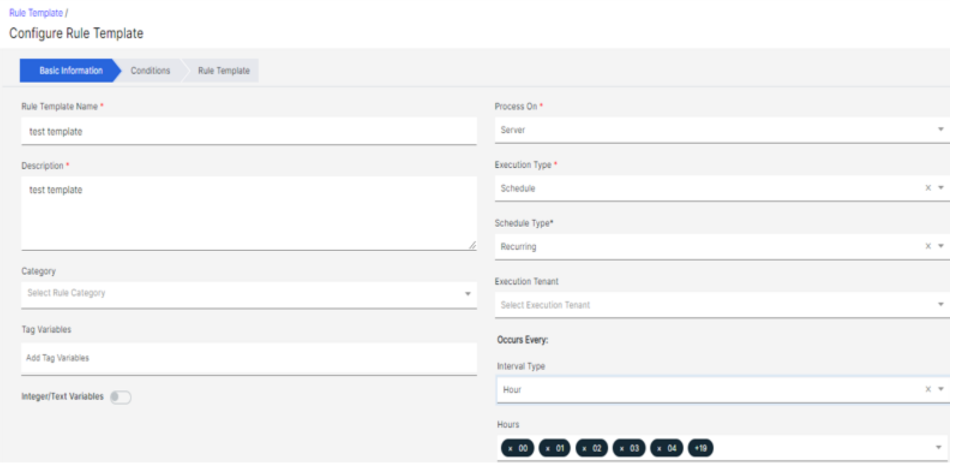
Description: LMTD

```python
import math


def main(arg1, arg2):
    try:
        value = None
        """write your code here"""
        log_value = math.log(abs(arg2))
        value = arg1 / log_value
        return abs(value)
    except Exception as e:
        print(f'Failed {e}')

```

Figure 4.5: Rule Function setup

6. Rule Templates

   A page for setting rule template. Here, we can specify the template name, description, category etc... In the tag variable column, we can specify the variables needed in this template. Here also we can specify the execution type as scheduled and recurrent just like in rule setup.



Configure Rule Template

Rule Template Name *: test template

Description *: test template

Category: Select Rule Category

Tag Variables: Add Tag Variables

Integer/Text Variables

Process On *: Server

Execution Type *: Schedule

Schedule Type*: Recurring

Execution Tenant: Select Execution Tenant

Occurs Every:

Interval Type: Hour

Hours: × 00 × 01 × 02 × 03 × 04 +19

Figure 4.6: Rule template

# Chapter 5

# Conclusion

The goal of **IOT MANAGER - EDGE MANAGEMENT** is to provide a powerful platform that effectively manages data from IoT devices in industrial settings. The Industrial Internet of Things (IIoT) generates a vast amount of real-time data, and proper data management is crucial for extracting valuable insights and improving industrial processes. With IoT Manager, organisations can achieve enhanced productivity, reduced expenses, improved uptime, better quality control, and overall business development.This platform offers real-time data management, alerts, and remote device monitoring, enabling organisations to leverage IoT technology for improved operations, competitive advantage, and data security compliance. The platform enhances all phases of the industrial life cycle, including machines, maintenance, and production. Implementing IoT Manager empowers organisations to harness the full potential of IIoT and drive their industrial processes towards greater efficiency, productivity, and success.

## 5.1 Future Enhancement

In the future, the system can be incorporated with more advanced analytics capabilities to gain deeper insights from device data, including predictive analytics and machine learning algorithms. This can enable proactive device management and predictive maintenance, optimising device performance and minimising downtime. The integration of AI technologies brings advanced analytics, automation, and predictive capabilities to the platform, enabling organisations to unlock the full potential of their IoT data. AI techniques can optimise resource allocation by analysing IoT data and identifying areas for improvement. For example, AI algorithms can optimise energy consumption, production scheduling, or inventory management based on real-time data and demand forecasts. This optimization can lead to cost savings, increased efficiency, and better utilisation of resources. Developing a mobile application for the portal to provide users with on-the-go access to device information, alerts, and management features, enabling remote monitoring and management of devices from anywhere, anytime.

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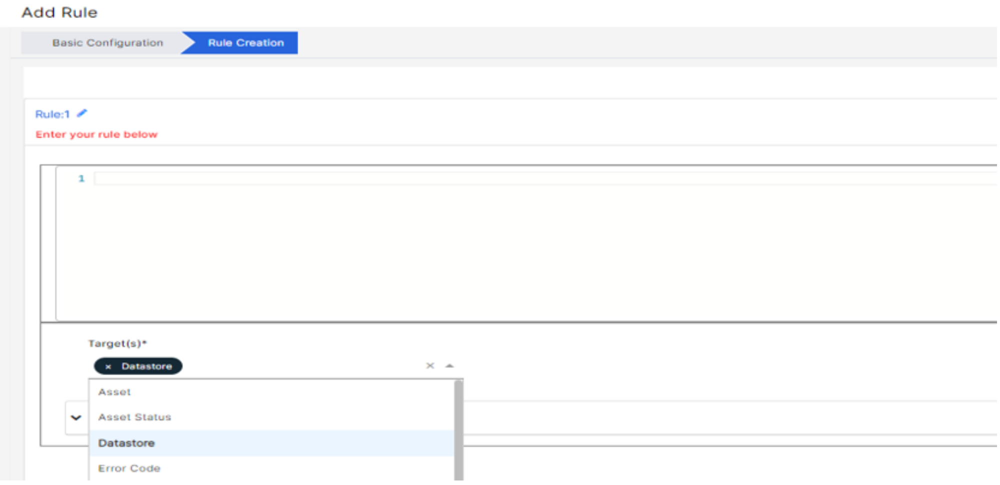
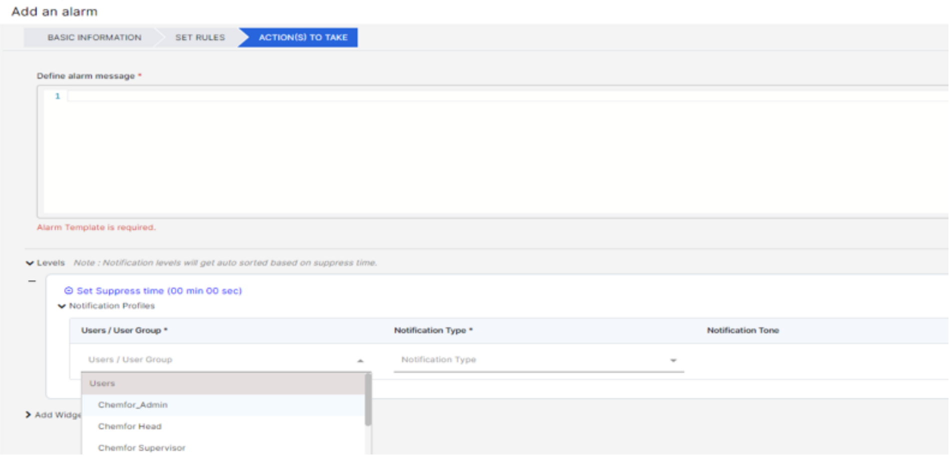
# APPENDIX

## Screenshots



Enter your rule below

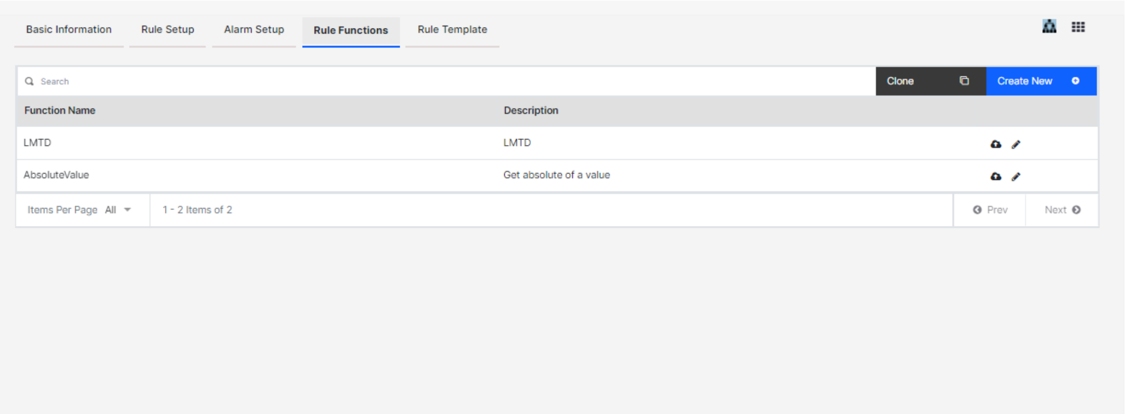
Figure A.1: Rule Creation



Alarm Template is required.

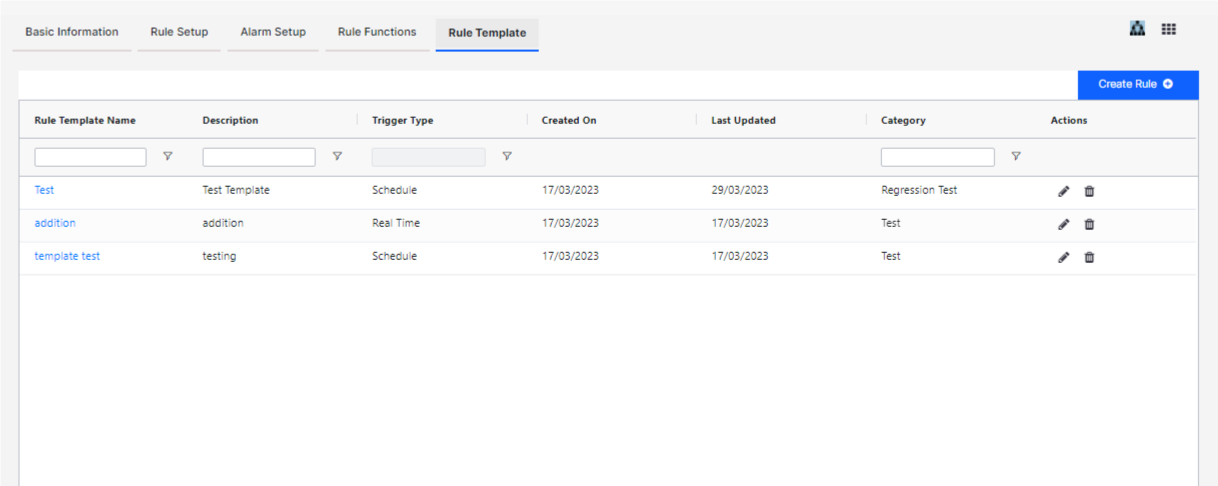
*Note : Notification levels will get auto sorted based on suppress time.*

Figure A.2: Action to take



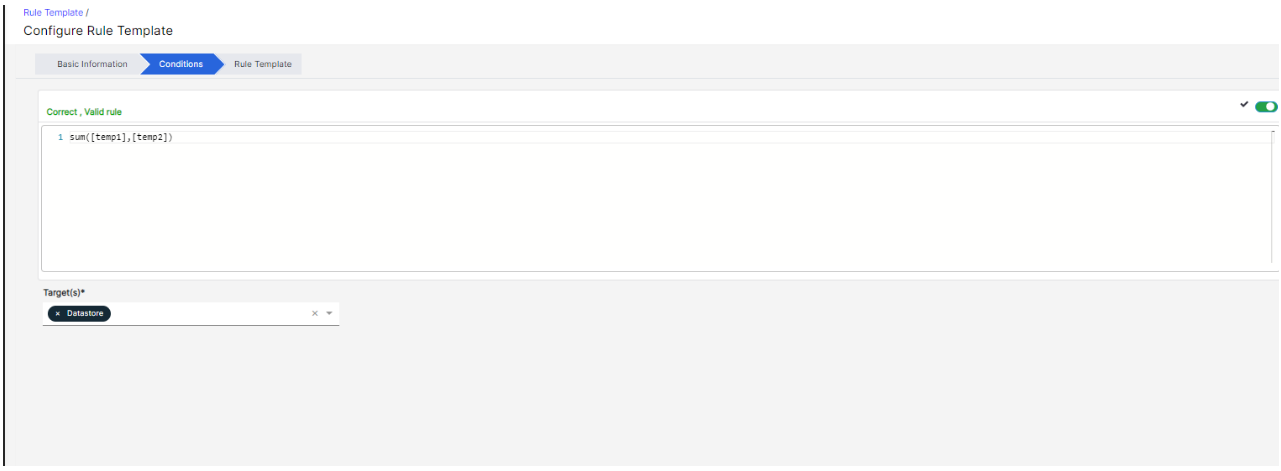
| Function Name | Description |
|---|---|
| LMTD | LMTD |
| AbsoluteValue | Get absolute of a value |

Figure A.3: functions created



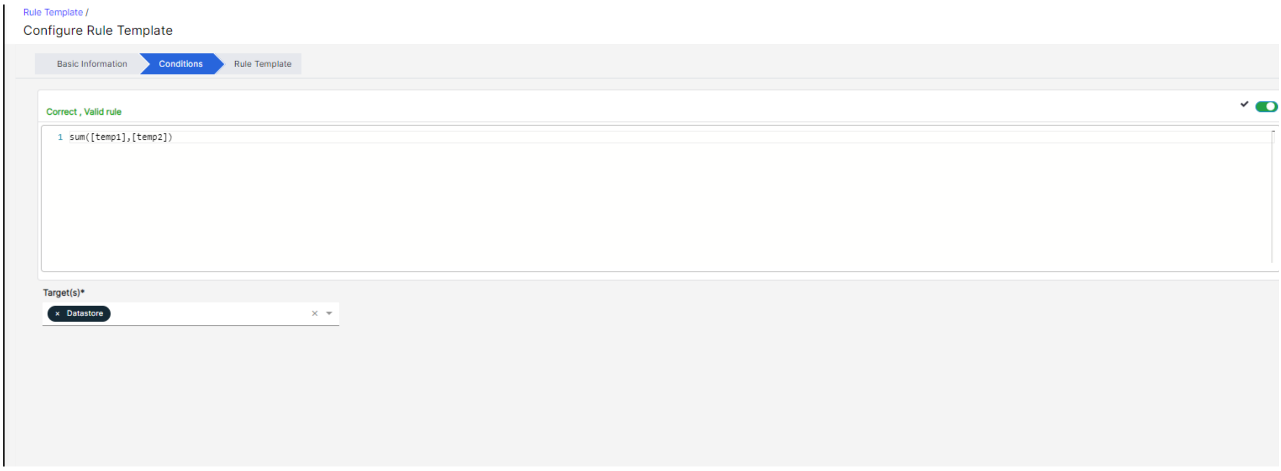
| Rule Template Name | Description | Trigger Type | Created On | Last Updated | Category | Actions |
|---|---|---|---|---|---|---|
| Test | Test Template | Schedule | 17/03/2023 | 29/03/2023 | Regression Test | |
| addition | addition | Real Time | 17/03/2023 | 17/03/2023 | Test | |
| template test | testing | Schedule | 17/03/2023 | 17/03/2023 | Test | |

Figure A.4: templates created



```
sum([temp1],[temp2])
```

Figure A.5: logic for template



```
sum([temp1],[temp2])
```

Figure A.6: parameter mapping