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Customer ticketing system with authentication using Google Firebase and automatic notifications to track the status of the ticket

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Abstract- **Ticketing system is very important as it helps the user to submit the issues faced by the user while using any household products like fridge, AC, electric bulbs, washing machines etc. This can be made efficient by tracking the ticket status whether is it is in open state , in progress, being resolved or closed state. Status tracking helps in achieving the exact idea of the issue being resolved. The ticketing system is implemented in a cloud architecture with the help of Google firebase which helps the user in accessing the ticketing system globally. With the help of firebase default security measures and asynchronusity multiple users can authenticate and use the application simultaneously. This is achieved by using asynchronous on both client and server. Firebase's real-time database is used to store the data of users and their tickets. This paper presents an approach for developing ticketing system using open source.**

Index Terms- **Real-time Database, Open Source, Firebase, CRM, Authentication**

I. INTRODUCTION

There will be many issues faced by the user while using the home appliances like washing machine, electric bulbs, fridge, Air conditioner etc. It is important to resolve all the issues faced by them. Hence a ticketing system comes into the picture. The user cannot keep a track on the issues by himself which will be a tedious task. All the problem giving household appliances can be tracked in a systematic way. This paper has focused to resolve this issue of following up of user to fix any issue in the home appliances. This paper has proposed a ticketing system where the user can file an issue and the rest of the thing is taken care by the ticketing system.

A ticketing system converts all the incoming support requests from multiple users into the ticketing system. From this system it will be easy to track and prioritize the issue by the user so that the ticket would be solved accordingly by the owner to whom the ticket assigned. The customer ticketing system is a CRM whose main goal is based on customer-centric, build customer trust, improve customer satisfaction, have good relationships with customers there by enhancing the competitiveness among the enterprises.[13]

Nowadays if the user finds any problem with the fridge say for example, then the user dial up a customer care of the company in which the fridge belongs to. The customer explains the issue with the fridge and then the customer care from the company notes it down and then he assures that it will be resolved in a day or 2 days of time. In this scenario, the company persons gets busy and forgets about the complaint or due to his negligence will fail to deliver within the assured interval of time. There will be no proper records in customer end to show the failure of the service until the customer lodges a complaint again. It is sometimes tedious task for the customer to follow up on the issue which was being filed. The follow up could be avoided by the user through sending notifications for three phrase in the ticketing system. Notification is sent in the First phase when the customer files a ticket about any problem will be in a "open" state. Notification is sent in the second phase when the ticket is in "being resolved" state and notification is sent in the third phase when the problem/issue is in the "closed" state. This helps in keeping track of the issue which was filed by the user instead of the user manually calling the customer care and tracking the issue.

In order to avoid all these tedious tasks of the customers and to resolve the untracked customer

tickets the customer ticketing system has been developed using open source firebase.

Firebase is an API that synchronizes application data across Web devices, Android and iOS and stores it on the Firebase database. The Firebase Realtime Database was the first product of the Firebase. The firebase gives a solution which assists software developers in building real-time collaborative applications. 1. Services provided by firebase are listed below:

- Firebase Cloud messaging(FCM):

FCM is a multi-platform solution for sending messages and notification for Android, iOS, and web applications at free of cost.[11]

- Firebase Authentication:

Using the client-side code users will be able to authenticate .This service is given by the firebase authorization. It supports social login providers Facebook, GitHub, Twitter and Google (and Google Play Games). Also, it has a user management system where the developers can be able to enable user verification with email and password login stored with Firebase.[7]

- Real-time database:

Firebase gives a real-time database and backend as a service. Application data can be synchronized across clients and stored on Firebase's cloud using an API by the application developers which is provided by this service[3] .Integration with Android, iOS, JavaScript, Java, Objective C, Swift and Node.js applications is enabled by the client libraries provided by the company[8]. The firebase's database is also approachable by a REST API and bindings for many JavaScript frameworks such as AngularJS, Ember.js, React and Backbone.js. The REST API utilizes the Server-Sent Events protocol, which is an API for making HTTP connections for accepting message pop-ups from a server. Designers utilizing the real-time database can verify their information by utilizing the organization's server-side-authorized security rules.

- Firebase Storage:

Firebase Storage gives secure report exchanges and downloads for Firebase applications, inspite of organization quality. The designer can use it to store pictures, sound, video, or other customer created content. Firebase Storage is bolstered by Google Cloud Storage [7]

- Firebase Hosting:

Firebase Hosting is a dynamic and static web hosting service. It helps hosting static documents, for example, CSS, HTML, JavaScript and different records, just as help through Cloud Functions .The service sends files over a content delivery network (CDN) through HTTP Secure (HTTPS) and Secure Sockets Layer encryption (SSL). Firebase accomplices with Fastly, a CDN, to give the CDN backing Firebase Hosting.

- Crash Reporting:

Crash reporting feature on google's firebase creates error reports in your application after its release. Errors are grouped into different groups as per how severe the error is. [11]

- Analytics

Analytics feature helps the application developer to understand how the users are using his/her application. The dashboard in the firebase gives details about the most used user , which feature is used the most by the users etc.[7]

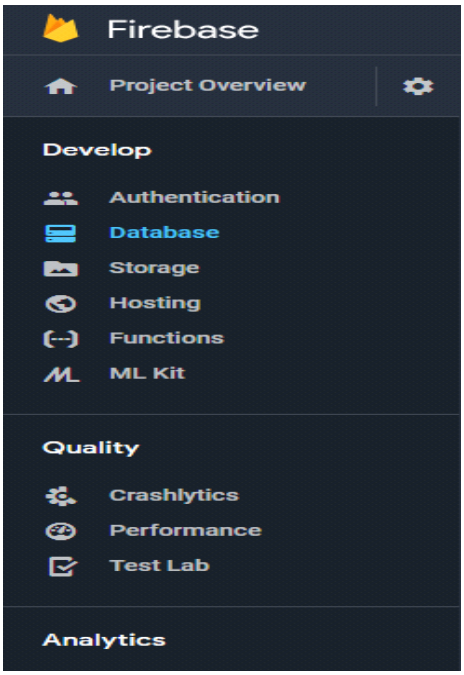

Fig 1: Features of firebase.

In this paper firebase authentication service, hosting and real-time database feature are being used to develop a ticketing system.

In Intel Technology, worked with Manoj Kumar Kuna, developed an indicator system for front end CAD execution and support tool for monitoring and tracking the employee performance in solving each ticket. This application was developed and deployed

in internal systems and for INTEL specific purpose. With the knowledge gained from the industry a similar project is been developed using Firebase.

2. Customer Relationship Management (CRM)

The fight to win clients is getting more grounded normally on account of the present business condition, depicted by an undeniably forceful competence. Organizations which center around their customer's needs and needs are in a better situation than gain whole deal ground than the people who don't [12] CRM is a information system setup between the clients and the associations to oversee contact exercises of both. Number of associations are anxious to grasp a client centric way to deal with serve customers[14]. The client ticketing framework is likewise a CRM which is created using Firebase.

There are many definitions of Customer Relation Management in the literature. Among the most representative, we could quote [15], who defines CRM as ‘‘a set of business processes and overall policies designed to capture, retain and provide service to customers’’, or [16], for whom CRM is ‘‘a coherent and complete set of processes and technologies for managing relationships with current and potential customers and associates of the company, using the marketing, sales and service departments, regardless of the channel of communication’’**.** In Fig. 2 , S.C. Hui, G. Jha, displayed the situation of traditional hot line service center, in which at whatever point a customer call to the service community for any enquiry, the call will be sent to the service engineer. The service engineer at that point propose and pose the arrangement of inquiries for finding the arrangement by utilizing past encounters from the database.[17]

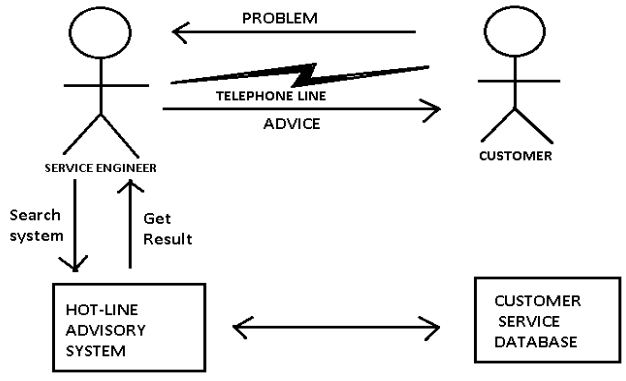

Fig 2: Traditional hot-line service center.

II. LITERATURE SURVEY

- **CHANGES IN MANAGEMENT SYSTEMS IN 1990’s: ERP**

The new framework for organization activities that rose in 1990s, described by the globalization of business sectors, innovative improvement, the bigger number of contenders, and expanded client requests, obliged organizations to restore their administration frameworks so as to adjust to the new competitive environment [18]. The dynamic of the change depended on both methodological and innovative components. Firstly, ideas and methodologies directed towards lessening costs and improving the nature of operational activities, for example, reengineering business processes, supply chain management, and so forth were consolidated. Secondly, innovative technologies became available, thus allowing organizations to manage humongous volume of data in an efficient way. A standout amongst the most significant of these advances was the ERP (venture asset arranging) PC programs [19]. Thus, organizations have accomplished a high level of maturity in utilization of PC applications to improve the effectiveness of the organizations regular activities. It is in this manner exceptionally normal, contingent upon their size or the division, for their operational level activities in the areas of accounting, sales, purchasing, warehousing, logistics, creation and HR to be electronic.

- **CHANGES IN MANAGEMENT SYSTEMS IN 2000’s :CRM SOLUTIONS**

The implementation of ERP produces an improvement in the quality and productivity of business processes. Nonetheless, when most of organizations in an area have upgraded their interior processes, this improvement turns into a condition that is important to stay in the market, yet stops to be an upper hand.

Accordingly, later on, separation from contenders will be based on the speed with which an organization is fit for reacting to the prerequisites and requests of the market with creative products and services[21]. In this way, despite the fact that customer care has dependably been an essential standard of business action, another model of customer relationship management (known as CRM) is presently vital so as to receive a customer centered type of association, which augments the esteem customers can anticipate from the organization and finds in the data got from the client the chance to set up business methodologies [22]. Likewise, from the

technological perspective, this new customer centered organizational model makes it important to supplement the ERP applications that have assumed a key job in the processes of advancing interior methodology (Business Process Re-building) and outside processes identifying with store network the executives with CRM Information Technologies (IT) solutions that assume a key job in client the executives procedures[23]

Author in [24] portrays the essential substance of Customer Relationship Management, builds model based on. NET architecture. Utilizing software engineering method, joined with the fundamental theory of customer relationship management, customer relationship management programming has been developed. This software has been utilized in a telecommunications organization, and has utilized impacts.

The customer relation management system is used in insurance companies to provide their customers a service of commitment portfolio for future security and compensation and the value of the insurance commodity is embodied not only in the insurance security available for customers, but also in services that the insurance services offered by the insurance company. Applying CRM technology to distinguish valuable customers from dangerous ones and conduct "fraud detection" plays an important role in sound operation of insurance company. CRM system leads to diversity and homogeneity of the insurance products.[25]

III. PROPOSED SYSTEM

CRM systems are used in wide range of domains .They are used in insurance companies, IT companies, Enterprises , transportation organizations etc. Each company would have their own CRM system to serve their respective customers. There is no CRM system where a customer can reach out to one system when there is come issue with a particular product/device.
This problem is resolved by proposing the customer ticketing system using firebase as shown in fig:3 .

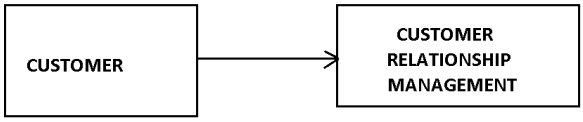

Fig 3: Proposed system of Customer ticketing system using Firebase

The proposed system is composed of sign-up module, sign-in module, database access and a customer relation management module.Fig.4 shows the Customer module of the proposed system .

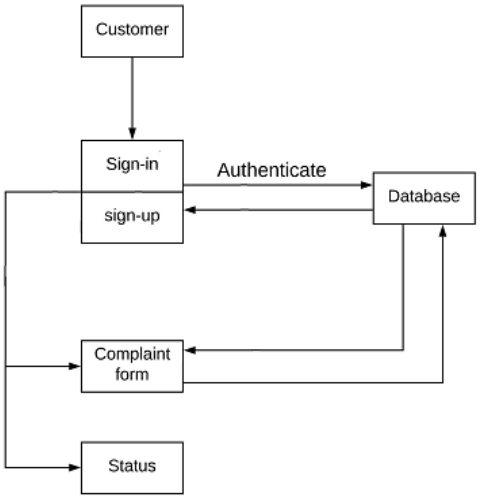

Fig 4. Customer Module of the proposed system.

- **DESIGN OF CUSTOMER AUTHENTICATION**

Customer authentication plays an important aspect in all the CRM systems. Authentication is facilitated by the Firebase in the proposed system.

- Sign-up/Registration Module: Sign-up module takes care of the authentication and authorization of the customer in the system. A new customer can register in the firebase by signing-up using customer's email-id and password. A verification email will be sent to the customer's registered email-id as Two step verification .Customer can confirm his identity by clicking on the link in an email. All the registered customer's details will be stored in the firebase's database. Customer can now be able to file a complaint about the product. The complaint form would contain the following fields:
  - Ticket ID(Auto generated)
  - Name of the product
  - Title (issue of the product)
  - Status of the ticket
  - Name of the person lodging a complaint

- Sign-in Module: Registered customer can sign-in directly after he has signed-up before. Customer can sign-in using the email-id and password. Once customer has signed-in, he can file a complaint about the product in the complaint form. Customer can track the status of the ticket in the status page.

- **STORAGE OF DATA IN DATABASE**

  Database Module:
  Firebase gives a real-time database and backend as a service. Application data can be synchronized across clients and stored on Firebase's cloud using an API. The registered customer's details will be stored in the firebase's database. All the complaint details filled in the complaint form by the customer will be stored in the database as shown in fig c.

- **CRM MODULE**

  CRM Module: Fig 5 shows the CRM module of the proposed system.

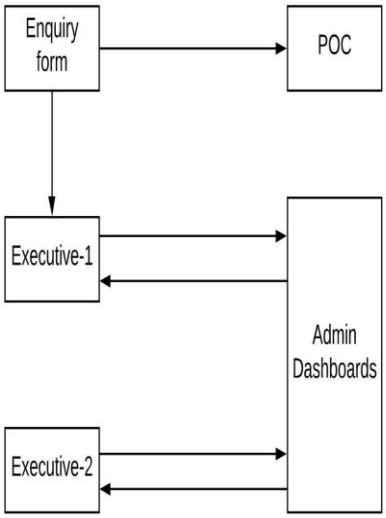

Fig 5: CRM module of the proposed system

The complaint filled by the customer will be fetched in an enquiry form having customer's ID, Product and its company's data .

POC: Enquiry form is accessed by the Point-Of-Contact (POC) who segregates the tickets to respective executives for different companies.

Executive-1: Executive will have the following data:

- ID (Auto Generated)
- Timestamp of the ticket filed
- Name of the Product
- Title(Issue of the product)
- Name of the person who submits/updates the ticket.
- Status of the ticket.

The executive looks into the complaint and tries to solve by contacting the customer. The ticket will be updated in the Status of the customer as "ticket is being resolved". If there is no response from the executive-1 within certain interval of time, then the ticket is pushed to the Executive-2.

Executive-2: The ticket is escalated to Executive-2 when ther is no response from the Executive-1. The ticket now becomes high priority ticket. The Executive -2 will have the same data available as that of the Executive-1. The status will be updated in customer's window as "Issue is being escalated". Periodical status in the customer's window will lead to easily tract the issue in the proposed system.

Admin Dashboard: Admin has all the access to the data that are available in the firebase database. Admin has the permission to do the following things:

- Accessiblity of all the data
- Can handle escalation of the tickets being unresolved
- Accessibility of the status in customer's wind.

- **IMPLEMENTATION**

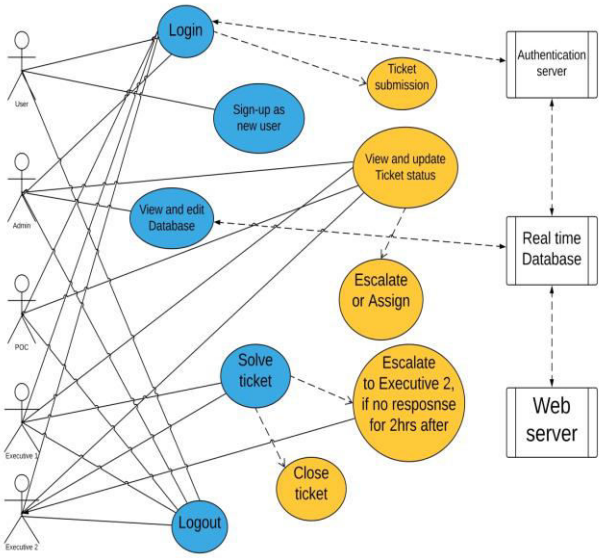

Fig 6: Use case diagram

The proposed system has user authentication module, Database module and the CRM module as shown in the use case diagram in Figure 6.

- Authentication module

User can register by clicking the sign-up button if the user is going to sign-in for the first time. This send a verification email to his/her email id by which he/she can confirm the registration. Once the user has signed-up, user can directly log-in as shown in the Fig 7.

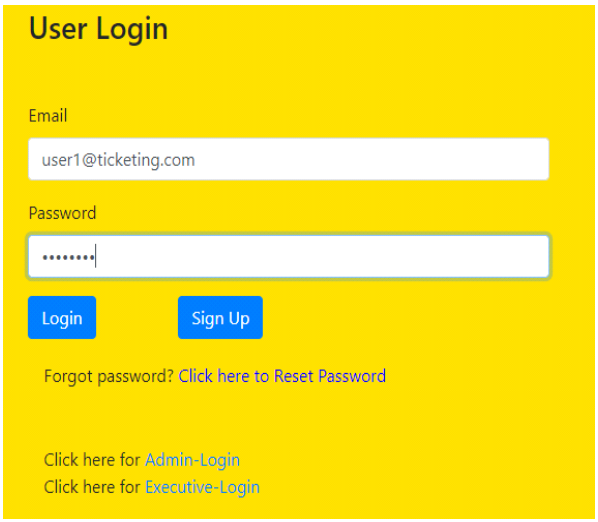

Figure 7: User login page

After successful login , now the user can fill the complaint form shown in Fig.8 which consists of ID- which is auto generated by the computer, Product- name of the product causing issue, Title- issue caused by the product, Status- status of the ticket , Updated by- name of the person who submits/updates the ticket.

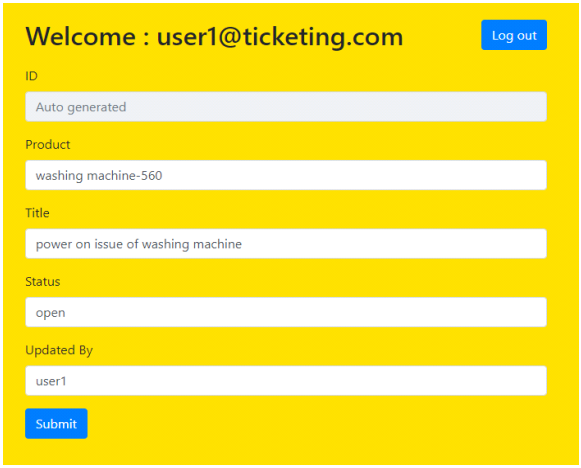

Figure 8: User complaint form

After successfully submitting the ticket , user can file many complaints if there exists or user can logout.

- Database module

Real-time database of the firebase is used to store the data in the firebase's cloud. In this application, soon after the user submits the data in the form it will be stored in the database. The data can be viewed in the firebase console in a hierarchical manner. Fig 9 shows how data is stored in the database.

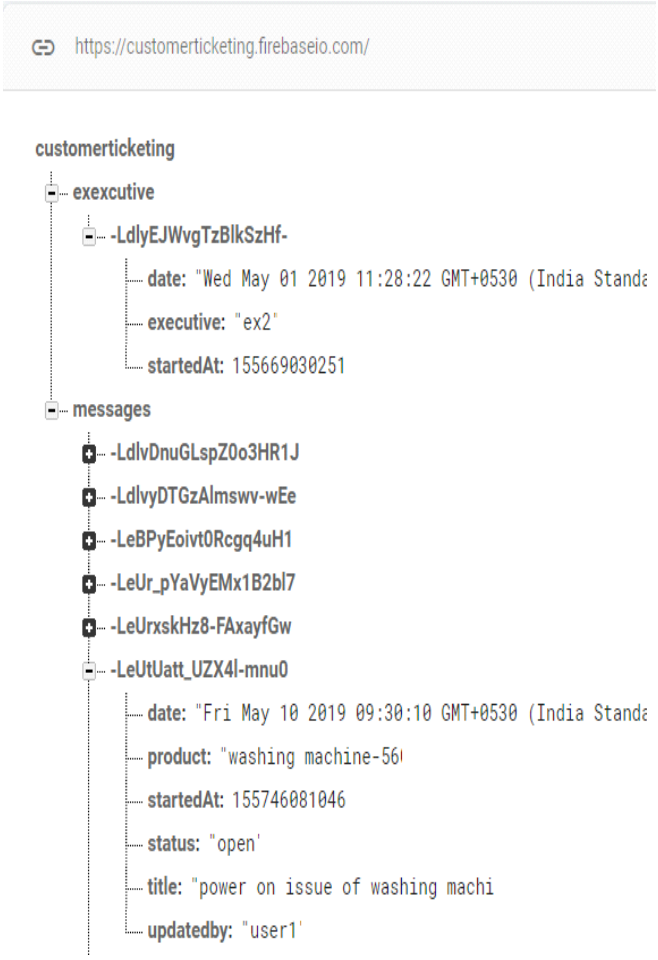

Figure 9: Data stored in the firebase.

- CRM Module

CRM module consists of POC (Point-Of-Contact), Admin and Executives.
After the ticket has been submitted by the user, POC logs in and pushes the respective ticket to the respective executive in which he/she would have expertise in as shown in Fig 10.
Example : in the Fig 10 POC allocates the ticket of the product 'washing machine 560' to ex1.

Fig 10: POC dashboard.

After the ticket has been assigned by POC to the respective executives, the data can be viewed by the admin using admin's credentials as shown in Fig 11.

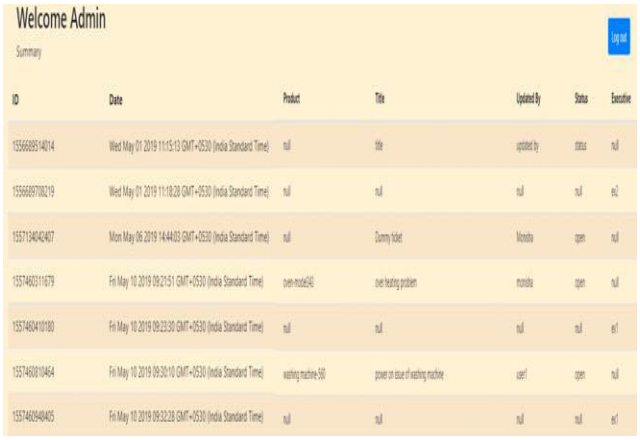

Fig 11: Admin dashboard.

All the allocated tickets could be viewed by the executives in their dashboard as shown in the Figure 12.

Fig 12 Executive 1 dashboard.

If the executive 1 fails to respond to the ticket in 2 hours then the ticket will be escalated to executive 2 . The admin can view and access all the information regarding the movement of the tickets and the respective notifications will be send to the user via email using the trigger email function.

IV. EXPERIMENTAL RESULTS

- Test Environment

The project is implemented on Windows 10 local environment using google's Firebase API and MVC architecture.

Based on the following factors application performance can be measured.

- Response Time: It is the duration between the HTTP Request sent and the HTTP Response received at client end.
- Throughput: It is a total number of requests that a server can handle per second. E.g. 100 transaction can handle per second.
- Workload: It is the amount of user load that can be handle by the server of that application. There can be two types of user load:
  - Simultaneous user load: The load when many active connections happening to the same website.
  - Concurrent user load: This load happens when the user hits the site exactly at the same moment.
- Resource utilization: Based upon the server and the network resources the cost of the resource utilization is calculated. Resources that consume during request processing are:
  - Memory
  - CPU
  - Disk I/O
  - Network I/O

Performance testing is the testing, which is performed, to learn how the segments of a system are performing, given a specific circumstance. Load test is a container of performance test and it runs performance test under certain load till it achieve their threshold limit. So in Load test same functionality (Admin client) will be controlled by different simultaneous clients.

Test Mix Model has multiple workflows where we can define based on the test cases. There are four model types that y can be provided.

- Based on the total number of tests:
  When a virtual users starts using the application, which web performance test will run more.
- Based on the number of virtual users:

It provides total percentage of the users that will be running a particular test case.

- Based on user pace.
  It provides frequency for particular test that will run how much times against per user per hour.
- Based on sequential order:
  Test case can be executed in a specified sequential manner. During load test, same specified sequential order will be followed through multiple loops until test load is complete.

In Graph 1, horizontal axis represents time duration with fraction of 10 seconds and vertical axis represents the number of users. The run load test is only for 10 minutes:

Key Indicator graph: selected the following resources from Counter set.

- User Load
- Pages/Sec
- Avg. Page Time

- Key Indicators

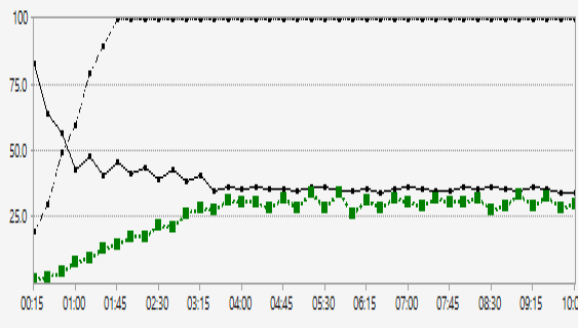

Fig 13:Key Indicators Graph

Counter	Instance	Category	Computer	Color	Range	Min	Max	Avg.
User Load	_Total	LoadTest:Scenario	DESKTOP-FH37FI5		100	20	200	170
Pages/Sec	_Total	LoadTest:Page	DESKTOP-FH37FI5		100	1.53	34.9	25.5
Avg. Page Time	_Total	LoadTest:Page	DESKTOP-FH37FI5		1	0.35	0.84	0.37

- Page Response Time

On chart, we can see how it performs when load is incremented. As load increments, its performance goes down. There are numerous properties that we can check against any page like Avg Page Time, Pages/Sec, and so on.

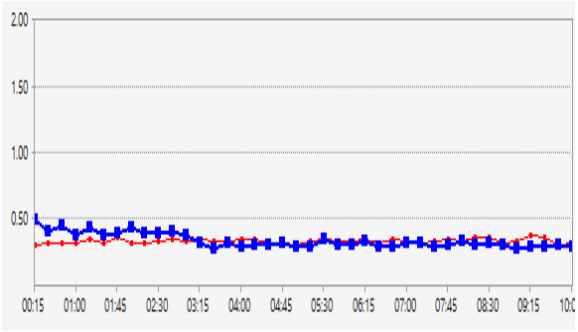

Fig 14: Page Response Time graph

Counter	Instance	Category	Computer	Color	Range	Min	Max	Avg.
Avg. Page Time	getAccountInfo{POST}	LoadTest:Page	DESKTOP-FH37FI5		2	0.31	0.38	0.35
Avg. Page Time	verifyPassword{POST}	LoadTest:Page	DESKTOP-FH37FI5		2	0.28	0.50	0.33

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