

The OSS Crew

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Our Business

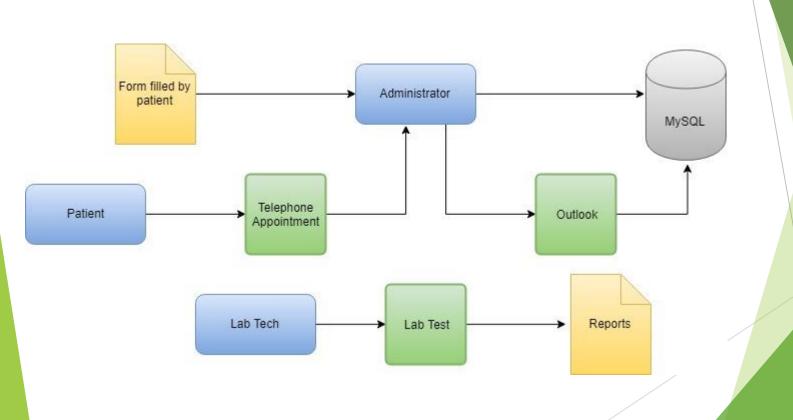
- Our vision is to make health management easier and faster for patients by connecting them with doctors and pharmacies
- The compassionate care provided by our doctors, nurses and other staff is a key to our success.
- Our expertise covers all specialties, from cancer to women's health.
- Risk and Mitigations Healthify is recognized for its advanced patient care and technology.

Existing System

- Health management portal using MySQL
- Manual Process includes :
 - Patients forms
 - Set up Appointment through telephone
 - Paper-based lab reports to be collected in person
- Provides facilities to maintain Patients, Doctors information



Existing System



Business requirement

The new system will provide below mentioned features:

- 360- degree profile view
 - Provide doctors with accurate past medical records of patients to provide better diagnosis and treatment
- Online Lab test result Management
 - Provide online facilities for patients and doctors to access the patient's lab test results online
- Virtual appointment
 - Scheduling an appointment for a skype visit. Conversing on a private chat with Doctor/Patients
- Connecting Pharmacy
 - A common platform to connect patients to pharmaceuticals to help patients get their medicines hassle free

Mission Statement

- Scale up the business features
- Better Service for our patients
- Implement advanced technology to organize sensitive patient data
- Identifying revenue streams via medical and business trends using analytics

Problem Statement

- Current Process is a manual process
- No centralization
- Many Physical documents.
- No feature to store video recordings in MySQL
- Images of Prescriptions and Lab reports cannot be stored in MySQL

Challenge With MySQL

Data Types

- · Unstructured data
- Semi-structured data
- · Polymorphic data

Volume of Data

- Petabytes of data
- Trillions of records
- Millions of queries per second



Agile Development

- Iterative
- Short development cycles
- New workloads

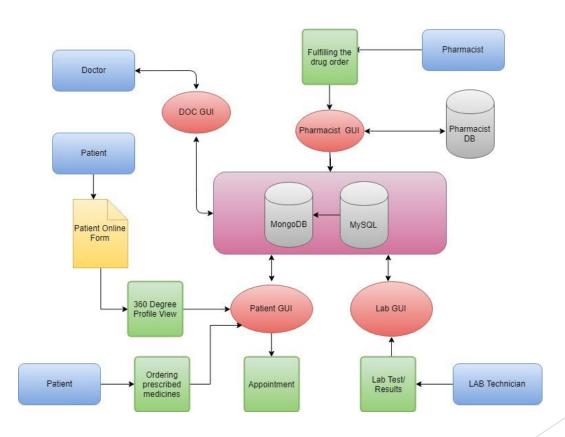
New Architectures

- Horizontal scaling
- Commodity servers
- Cloud computing

https://www.slideshare.net/matkeep/migrating-from-relational-databases-to-mongodb

The Solution - MongoDB

Proposed System



Why MongoDB?

- MongoDB is a free and open-source cross-platform
- NoSQL database program, uses JSON-like documents with schemas
- Supports dynamic schema design, allowing the documents in a collection to have different fields and structures
- Automatic sharding enables data in a collection to be distributed across multiple systems for horizontal scalability as data volumes increase.

Comparison

NAME	MongoDB	Cassandra	MySQL
Description	One of the most popular document stores	Wide-column store based on ideas of BigTable and DynamoDB	Widely used open source Relational Database Management System
Primary database model	Document Store	Wide Column Store	Relational DBMS
Implementation Language	C++	JAVA	C and C++
Server Operating System	Linux OS X Solaris Windows	BSD Linux OS X Windows	FreeBSD Linux OS X Solaris Windows

https://www.linkedin.com/pulse/real-comparison-nosql-databases-hbase-cassandra-mongodb-sahu/

Comparison continued...

NAME	MongoDB	Cassandra	MySQL
Data Scheme	Although Schema Free, documents of the same collection often follow same structure	Schema Free	Fixed Schema
Secondary Indexes	Supported	Restricted	Supported
Triggers	Not Supported	Supported	Supported
Foreign Keys	No (typically not used, however similar functionality with)	NO	YES
In Memory Capabilities	Supported	Not Supported	Supported

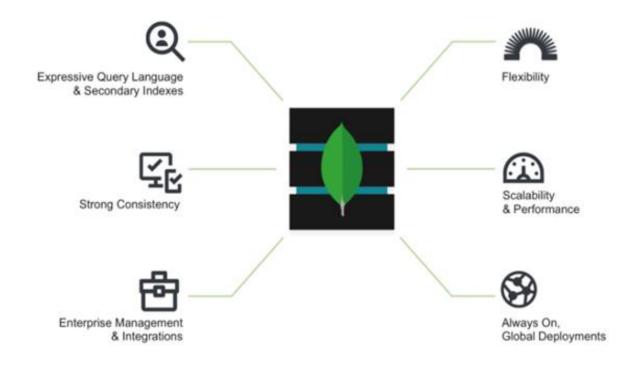
Comparison continued...

- In MongoDB, data is represented in a collection of JSON documents while in MySQL, data is in tables and rows. JSON documents can compare to associative arrays when using PHP and directory objects when using Python.
- MongoDB has a Map Reduce feature that allows for easier scalability. This means you can get the full functionality of MongoDB database even if you are using lowcost hardware.
- We do not have to come up with a detailed DB model with MongoDB because of is non-relational.

Comparison continued...

- MongoDB main purpose is to assist in data storage and the solution can indeed store documents on the World Wide Web.
- One of its most outstanding features is data storage in a dynamic schema.

MongoDB - Architecture



MongoDB: Capabilities

- ✓ Flexible Data Model
- Scalability and Performance
- ✓ Always-On Global Deployments

JSON Data Model with Dynamic Schema Auto-Sharding for Horizontal Scalability

Flexible, Full Index Support Rich, Document-Based Queries

Built-In Replication and High Availability

Fast, In-Place Updates

Aggregation Framework and Map/Reduce

GridFS for Large File Storage

Upstream

- MongoDB dependencies v3.6:
 - Apache¹ Provides back end GUI support
 - Java Allows for creation of Javascript queries
 - MapReduce³ Provides data aggregation features
 - WiredTige⁴ Internal data storage method for documents

1https://en.wikipedia.org/wiki/MongoDB https://docs.mongodb.com/manual/applications/drivers/index.html https://www.mongodb.com/products/spark-gonnector

2 https://docs.mongodb.com/manual/applications/drivers/index.html

 ${\tt 3-\underline{https://www.zdnet.com/article/mongodb-3-0-gets-ready-to-roll-with-wiredtiger-engine-onboard/2000}}$

4 https://docs.mongodb.com/manual/core/map-reduce/

Downstream

- ☐ MongoDB Modules v3.6:
 - Compass Provides GUI support for data visualization, also API support for 3rd party management software
 - Atlas₂ Provides cloud support and management for a distributed virtualized shard deployment
 - Stitch Back end support and integration for external applications along with API access, also provides application management services.

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¹ https://www.mongodb.com/products/compass

Mongo Partners

Software & Services





















APPDYNAMICS

Cloud & Channel





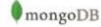


Hardware









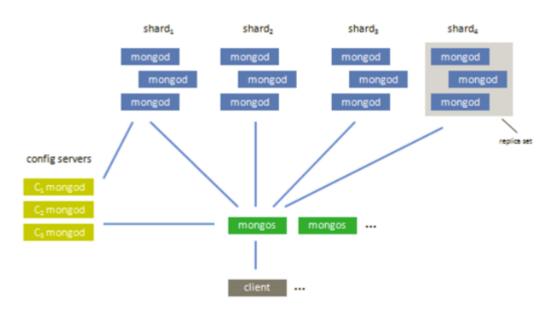
MongoDB Deployment

- MongoDB can run on Windows, Linux, Solaris, and FreeBSD
- Internal Java environment with Apache dependencies
- Supports web GUI
- Sharding allows for distributed data and increased resiliency of the system along with increased throughput with more simultaneous transactions.

1

Sharded Architecture

Sharded deployment example



Platform Support

- Healthify intends on hosting it's own physical servers running on VMs in a sharded deployment on Windows servers to maintain physical control of the data. Long term options for offsite backup can be an AWS server with dedicated resources depending on future cost analysis.
 - Cloud environments AWS EC2, GCP, MS Azure
 - dotCloud, Rackspace, Redhat Openshift, VMware Cloud Foundry

360- degree profile view:

Using MongoDB, we can add a new feature to our application that provides a complete view of the patient's profile, aggregating patient's medical bills, prescriptions, lab test results and other relevant history. It can serve more patients in less time.

Online Lab test result Management:

- Using MongoDB, we can upload large test results which will be available for patients and doctors under patients profile.
- Both Patients and Doctors can access them online for referring during the patients appointment

Virtual appointment:

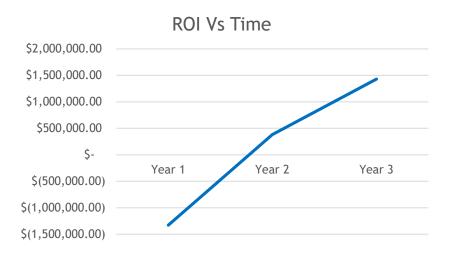
This will allow patients to have an appointment with a doctor online from anywhere, as per their convenience. Also allow patients to save the appointment for future reference.

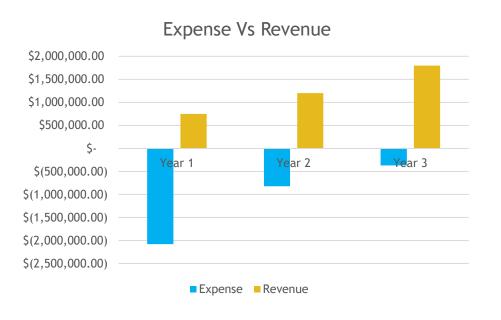
Connecting Pharmacy:

This will allow patients to have an appointment with a doctor online from anywhere, as per their convenience. Also allow patients to save the appointment for future reference.

	Year 1		Ye	Year 2		Year 3	
Migration Cost							
Number of Employee		10		0		0	
Cost per employee For 4 mont	\$	(20,000.00)	\$	-	\$	-	
Total	\$	(200,000.00)	\$	-	\$	-	
Front Desk Labour Charge							
Number of Employee		5		3		1	
Cost per employee	\$	(40,000.00)	\$	(40,000.00)	\$	(40,000.00)	
Total	\$	(200,000.00)	\$	(120,000.00)	\$	(40,000.00)	
Server Maintainance Cost							
Cost for Maintaining MySQL	\$	(80,000.00)	\$	-	\$	-	
Cost for Maintaining	\$	-	\$	(50,000.00)	\$	(30,000.00)	
Total Cost	\$	(80,000.00)	\$	(50,000.00)	\$	(30,000.00)	
Ongoing Development Cost							
Number of Employee		20		0		0	
Cost per employee	\$	(80,000.00)	\$	-	\$	-	
Total	\$(1,600,000.00)	\$	-	\$	-	
Employee Training Cost							
Number of Employee		0		50		0	
Cost per employee	\$	-	\$	(1,000.00)	\$	-	
Total	\$	-	\$	(50,000.00)	\$	-	
Application Maintainance Cost							
Number of Employee		0		10		5	
Cost per employee	\$	-	\$	(60,000.00)	\$	(60,000.00)	
Total	\$	-	\$	(600,000.00)	\$	(300,000.00)	
Total Expense Per Year	\$(2,080,000.00)	\$	(820,000.00)	\$	(370,000.00)	

Revenue From Business				
Number of Patients		5000	8000	12000
Revenue from Doctor	\$	740,000.00	\$1,185,000.00	\$1,777,000.00
Revenue from Lab Tests	\$	10,000.00	\$ 15,000.00	\$ 23,000.00
Total Revenue Per Year	\$	750,000.00	\$1,200,000.00	\$1,800,000.00
ROI Per Year		-63.94%	46.34%	386.49%
Total ROI in 3 years		14.68%		





Return on Value

Value Factors	Value Source	Value
Competitive Edge	Better market position	 Since we are first in the market to launch virtual appointments the business value of the company increases. Increased revenue as seen in ROI
Optimization	Service Optimization	 Our application is optimized for all web browsers and for mobile platforms.

Return on Value

Value Factors	Value Source	Value	
Patient Experience Management	Satisfied Customers	 Improve customer satisfaction levels by providing online appointment facilities. Provide access to patient medical history under one click Increase customer retention by providing quality service 	
Service Improvement	Online facilities	 Customers can send prescription to the pharmacists directly through the application which reduces the wait time. Customers can reschedule appointments without calling the doctors office. 	

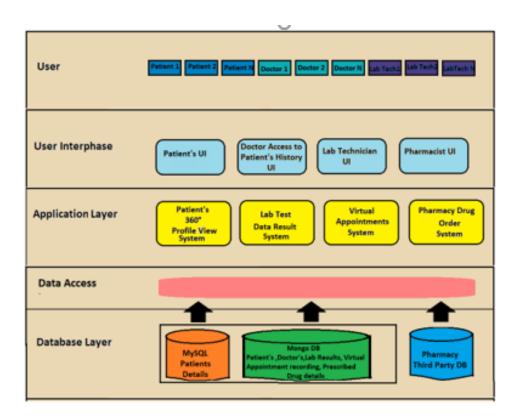
Stakeholders

- Patients Patients can converse with their care providers, access medical records, scheduling, billing, prescriptions, and other features
- Medical Personnel Doctors and Nurses have access to patient medical records, converse with the patient, and can request services like lab, medication, or referrals to specialists.
- Lab Technician- Lab technicians can receive lab test requests and upload results

Stakeholders

- Pharmacist Local stores that are tied into the system to receive prescriptions and also for mail delivery and online renewal
- Administrator Hospital staff performing billing, scheduling, and other administrative functions
- IT Personal Ensures HIPPA compliance and maintains administration of the system, user accounts, and permissions

Architecture



Personas

Patient - Lara Brown, 44

- Description
 - Marketing manager @ medium-sized tech company
 - Married, 3 kids
 - Inflexible schedule, some travel required
- Goals
 - Have access to Healthify serves at her convenience
 - Busy with research and cannot always remember her medical and prescription history.
 Would like her and her doctor to have easy access to medical history
 - Believes advancements in video calling tech can enable her to consult virtually w/doctor and have an archive of that call
 - Would like prescriptions delivered home, like she does with groceries

Doctor - Thomas Vance, 31

- Description
 - New family physician at Healthify, serves Brown family
 - Loves working at Healthify and serving patients
 - Thinks current documentation system is outdated and frustrating, "A mess of spaghetti."
- Goals
 - Have a more unified platform to track patients and documentation
 - Have a clearer view of patient's medical history and needs with that documentation
 - Consult with patients virtually at their convenience
 - Quickly identify most convenient pharmacies to have fulfill prescriptions

Lab Tech - Jonah Woods, 24

- Description
 - One of several lab techs at Healthify
 - Studying at medical school
 - Feels current system is outdated and that results should be handled digitally
- Goals
 - Remove the need to have physical documents for lab results
 - Remove the need for those physical documents to be scanned into a flat file system

Pharmacist - Maria Samson, 37

- Description
 - Works at local pharmacy branch serving patients from multiple hospitals and health
 - clinics, including Healthify
 - Pharmacy has implemented latest technologies to track and manage medicine supplies
 - Concerned that clinics that don't update their own systems will waste patient's time
 - sending them to pharmacies that can't fulfill prescriptions
- Goal
 - Have a system that can interface with her branch's medicine inventory remotely,
 - so hospitals and clinics have a better idea of which pharmacies can
 - best fulfill requested prescriptions

User Scenarios

User Scenarios (Contd.)

Who	What	Why	Acceptance Test
Patient	Healthcare provider to have a clear idea of my medical history	To better fulfill my needs	On request, system will accept updates to profile from users of the system
Doctor	A complete view of my patient's medical profile and history	To more efficiently diagnose their issues and prescribe medication	On request, system will provide and format all relevant data on a patient
Lab tech	See what tests are required and quickly update them with results	To help the doctor analyze the results	System will display requested tests for a patient and accept updates from the lab

User Scenarios (Contd.)

Who	What	Why	Acceptance Test
Patient/ Doctor	To consult face-to-face over the internet and have an archive of that consultation	Convenience and future analysis	A virtual consultation is recorded and available for viewing after the consultation

User Scenarios (Contd.)

Who	What	Why	Acceptance Test	
Doctor	Send a patient's prescription to a pharmacy within our network and have it fulfilled	To ensure the patient is receiving their assigned medication		
Patient	View my prescriptions on the Healthify service and have the medication delivered to my home	Convenience to fit my busy life		
Pharmacist	View a patient's full prescription history	To ensure there are no medical conflicts between medications		

High-Level Requirements

Business Requirements

- 360-degree profile view
- Online Lab Test Result Management
- Virtual appointments
- Connecting Pharmacies

High-Level Requirements

Functional	Non-Functional
System must integrate with existing Healthify MySQL Database	System will use middleware to collate data from MongoDB and MySQL databases
System must have partitioned permissions with regards to record access and updates	System will have a maintained permissions file using MongoDB "Users and Roles" that is kept at parity w/MySQL database via AD
System must be regularly backed up	System will dump daily database backups to vault machines (see Risks and Mitigations)

High-Level Requirements

Functional	Non-Functional
System must not allow remote modification of sensitive information	 Remote access via web portal will have limited access to information Remote access to the database will be refused

High-Level Requirements -360-degree Profile

Functional

System must aggregate patient's relevant medical history on demand Relevant medical history includes, but is not limited to: bills, prescriptions, operations, and lab results

Non-Functional

- System will accept and validate provided criteria from interested parties
- System will retrieve relevant patient data from MondoDB based on criteria
- System will present retrieved data
- System will accomplish the above tasks in less than 30 seconds
 barring client network latency

HLR - 360-degree Profile View(cont.)

Functional	Non-Functional
System must accept updates to patient's medical history via web form or file upload	 System will accept and validate data presented by client System will accept file uploads including, but not limited to: CSVs, PDFs, images, and video System will update the patient's record System will notify client when update is complete

High-Level Requirements - Doctor Search

Functional	Non-Functional
System must retrieve information	System will accept and validate provided
about doctors on demand	criteria from interested parties
Information includes, but is not limited to: specialization,	 System will retrieve data on requested doctor
availability, location	 System will present retrieved data
	 System will accomplish these tasks in less
	than thirty seconds barring client network
	latency

High-Level Requirements - Doctor Search

Functional	Non-Functional	
System must match patients to a number of doctors based on patient needs and doctor specialties	 System will retrieve patient information System will retrieve a list of doctors based on doctor specialties 	
	 System will retrieve information for each doctor System will display top 5 matched doctors 	

High-Level Requirements - Virtual Appointments (cont.)

Functional	Non-Functional	
System must handle appointment scheduling	 System will accept a patient's requested doctor, date, and visitation type (in-person or virtual) System will retrieve requested doctor's availability System will determine if the doctor is free on the requested date System will record the appointment if doctor is free 	

High-Level Requirements - Virtual Appointments (cont.)

Functional	Non-Functional
System must notify patients & doctors about upcoming scheduled appointments via secure webmail	 System will push reminders on set intervals via internal user portal System will push a notification via email

High-Level Requirements - Virtual Appointments

Functional	Non-Functional
System must record and archive virtual appointments	 System will initiate a video recording of the appointment at the listed start time System will stop recording the appointment at the listed stop time System will store the recording under the patient's profile in MongoDB using MongoDB GridFS

High-Level Requirements - Connecting Pharmacies

Functional	Non-Functional
System must integrate	System will store connected pharmacies'
with connected	information
pharmacies' inventory	System will store required authentication
databases	information in an encrypted form

High-Level Requirements - Connecting Pharmacies

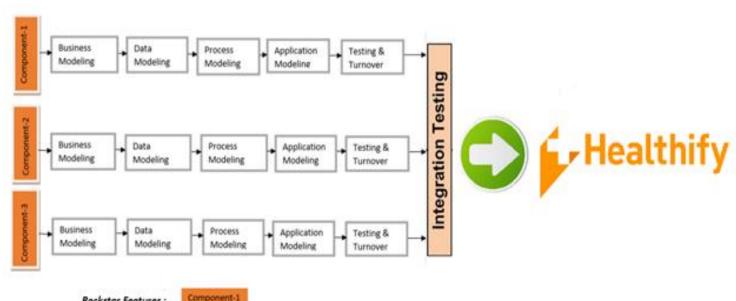
Functional	Non-Functional
System must notify doctors and patients of "most convenient" pharmacy for prescription	 System will accept prescription information System will connect to and authenticate with pharmacies within 25 miles System will query determine which pharmacies can fulfill prescription System will determine which pharmacy is closest to Healthify office or patient's home System will determine "most convenient" pharmacy by distance and shipping costs

High-Level Requirements - Connecting Pharmacies

Functional	Non-Functional
System must notify pharmacists about requested medications and previous prescriptions to determine medical conflicts	 System will retrieve current prescription System will retrieve patient's information System will present retrieved data

SDLC Model

SDLC Model: RAD with Rockstar feature



- Rockstar Features:
- Component -1: 360 degree profile view
- **Component -2: Virtual appointment**
- **Component 3: Connecting Pharmacy**

Why RAD with Rockstar model?

- The features are independent of each other and their development stages can be begun simultaneously or concurrently, hence we identified the model to be RAD
- Since all the functionalities revolve around the entity patient, we identified
 360 degree profile view as our rockstar feature

SDLC Steps

Requirement gathering and analysis

- Gathering Business requirements :- Conducted surveys for patients and doctors and identified the problem areas to be as follows:
 - Struggling to consolidate medical history
 - Difficulty in scheduling appointments and going for personal visits to hospital/Clinic
 - Inconviniency in collecting medicines from pharmacies
- Analysis: After researching about the alternatives, the team came to a mutual agreement that MongoDB fulfills the current requirements and will integrate with existing system perfectly

Test Plan



https://www.google.com/search?q=alpha+testing+and+beta+testing&source=lnms&tbm=isch&sa =X&ved=0ahUKEwj69vb80rbbAhXJwFQKHVxmBYAQ_AUICigB&biw=1707&bih=735#imgrc=BD KttlveE4Uw3M:

Internal Alpha

- Initial alpha test will focus primarily on integration and system testing
- Primary focus is on basic interaction between subsystems and interconnectivity of the various databases.
- Minimum Feature requirement for Beta is working connections between the Medical Personnel, Patients, and Lab.
- Pharmacy Access can be finalized in Beta.
- Alpha will only focus on web browser access of systems, with support of latest Edge, Chrome, Firefox.
- Mobile support to be a Beta Test Feature.

Beta Test

- Pharmacy Access can be finalized in Beta.
- Primary focus will be on System testing
- System will be subject to stress testing
- Heavy GUI testing with beta users of all persona types, for several iterations to ensure menus and work flows are simple and intuitive.
- Heavy access also on Security. User permissions, access controls, and protections must be in place. No actual patient information to be used initially.

Beta Test Continued...

- As security requirements are fully tested, user tests can start transitioning to using live systems as testing nears release and Beta user scope can be increased.
- All features must be fully operable and integrated, no high severity high impact bugs.

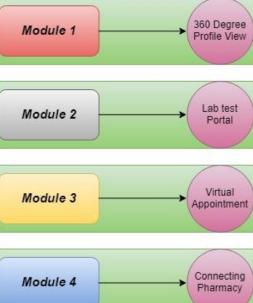
Bug Tracking

Bug Tracking

- The system will be using Remedy[1] for bug tracking and long term service requests
- Bugs will be tracked by Priority and Severity
- Bugzilla will be used to manage changes
- Initial focus will be on performance impacting bugs during Alpha and Beta stages
- Post launch focus will shift more towards user features with a high emphasis on GUI and usability complaints to reduce overall incoming ticket volume

Implementation

All features (360 degree profile view, Virtual Appointments & Connecting parmacies) being independent from each other, Teams will begin working on different features simultaneously.



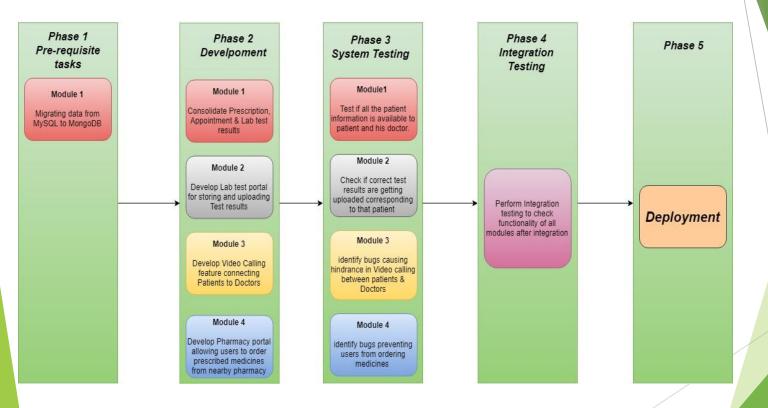
Release Criteria

- The application should be supported by latest browsers such as Edge, Chrome, Firefox and also through mobile platforms.
- System should integrate with existing Healthify MySQL Database.
- System should aggregate patient's relevant medical history on demand.
- System should accept updates to patient's medical history via web form or file upload.
- System should integrate with connected pharmacies' inventory databases.
- System should record and archive virtual appointments.

Release Criteria

- All the bugs found in the testing phase should be documented and be resolved
- All QA tests should run at 100% of expected coverage.
- All acceptance tests must pass.
- The application must be tested in beta phase for at least 100 hours
- HTTP Responses complete within 300 milliseconds
- System should be capable of supporting over 10,000 concurrent users

Deployment



Maintainance

- After successful implementation and deployment, system will require support and assistance in case of issues
- We will have our trained database administrator to provide assistance whenever required
- Monitoring of servers and database is continuously done for ensuring the system availability

Company Roadmap

Phase 3:

Integrate all components and perform overall testing (May'18-June'18)

Phase 1: Requirement

Gathering & Analysis (April'18)

Phase 4:

Deploy the System to users (June'18)

Phase 2:

Begin Development of all components in **Parallel** (April'18-May'18)

https://www.google.com/search?q=company+roadmap&source=Inms&tbm=isch&sa=X&ved=0ahUKE /pQBvwQ_AUICigB&biw=1707&bih=735#imgdii=LjfEP0OQqssCUM:&imgrc=it4x1X-_AOvFXM:

Risks and Mitigations

Risks and Mitigations

Risk	Severity	Mitigation
Data loss	High	 Daily database backups via script Backups stored on "vault" machines built solely to store data and remain disconnected from main Healthify services

Risk	Severity	Mitigation
Data breach	High	 Database access permissions granted via MongoDB "Users and Roles" by in-house DBA Permission and access logs audited regularly by independent InfoSec Officer. Database server only accessible via Ethernet No remote access permissions Passwords should be reset regularly to strict standards

Risk	Severity	Mitigation
Network Failure	High	 Maintain backup internet connections from secondary ISPs Network admin should be capable of changing network configs to minimize downtime

Risk	Severity	Mitigation
Internal Culture Resistance	Medium	 Employees given training on new system to acclimate them to new system Address employee concerns during development & rollout

Risk	Severity	Mitigation
Data not up-to-date	Low	 Require regular updates of data via triggers Eg: A patient that hasn't updated their vaccinations within a year will be notified to update vaccinations via secure web portal or request an appointment with primary doctor

Success Metrics

- No. of concurrent user- system is able to concurrently handle traffic upto 10,000 users
- Query response time- query response time is less than 300 ms
- Virtual Appt users are able to make virtual appoints with the doctor without any lag
- Pharmacy there is a increase in number of orders to the pharmacy and the waiting time is also reduced for the user as the user can send the prescription to the pharmacy using the application
- Self service users are able to book and reschedule appointments by using the application removing the need to call the doctor's office.

Business Values

- Hassle free delivery of medicines at home
- Increased revenue due to virtual appointments
- Increased profits in terms of medicine sales from pharmacies
- Reduce the potential for malpractice and improve healthcare

Benefits and Conclusion

Benefits

- Increase patients served with convenient service, increase net profits
- Improve internal workflow and consistent service
- Improve stability and security with standardized and secure servers

Conclusion

- At Healthify, our vision is to make health management easier and faster for patients by connecting them with doctors and pharmacies.
- With our plan, we will create a modern and convenient system for patients, employees, and pharmaceutical partners.
- With our new system, we will ensure more patients have access to the most advanced healthcare system available.

Thank You!