BotMan

An enterprise-grade framework for chatbot development

SAN JOSÉ STATE UNIVERSITY

Project Workbook

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Chapter 1. Literature Search, State of the Art

Literature Search

With recent developments in the field of technology, people these days are adopting new means of communication. It has been observed that the use of messaging applications like Facebook, WhatsApp, HipChat are on the rise. In a study published by Flurry in their annual State of Mobile report 2016, it was found that the average time spent by an individual on social and messaging applications grew four times over the last year. The use of messaging applications is not only limited to the social platforms but also has penetrated the commercial space. Many companies are using chatbot on messaging channels as a means for customer service. Companies also use bots on their communication channels to take care of the day to day mundane tasks like answering the queries of employees, broadcasting a timely notification of important events, etc. Recent development in the field of Artificial Intelligence is helping us to make chatbots more intelligent and human-like. They can now even analyze and predict human sentiments and respond appropriately.

A blatantly evident reality faced by the app economy is that these days people are abandoning downloading application more than ever. According to a report by Digital Trends, only 16 percent of people try using an application more than twice. In the past 5-7 years, users have already grown tired of bouncing between too many applications or learning how to use a new interface after every new download. Studies show that the applications that users prefer to use on their mobile devices are the ones which act as a single access point to the services provided by multiple applications combined.

Moreover, there has been a shift in the way people prefer to communicate. They are now getting inclined towards chatting application over any other way of communication. People are now spending more time in messaging applications than on social media and that is a huge turning point. Messaging apps are the platform for the future and bots would be the way how users would access all sorts of services over the internet.

Natural language processing (NLP) is yet another area of research which is gaining increasing popularity. It aims at understanding how people organize their thinking, feelings, language and behavior to produce results competent to that of humans. The reason why so many bot platforms are popping up is the advent of many NLP services. Connecting to a channel and developing bots was not a problem, the missing link here was a platform which could understand the intention of the users and reply intelligently. NLP platforms like api.ai, wit.ai and many others have now bridged this gap. This gives users an illusion that they are talking to a person rather than a machine.

While chatbots seem to have a promising future, many things need to be taken care of to successfully configure and maintain it. Selecting a cloud infrastructure to host the chatbot is one of the crucial things to think about. The cloud platform should be reliable enough to maintain high service availability. Another consideration is selecting an NLP platform which could quickly understand the user's intention and reply appropriately. The model should be able to learn quickly and scale its knowledge starting with a limited dataset. More importantly, the chosen platform should handle error conditions gracefully.

State-of-the-Art Summary

Cloud platforms are advancing at a rapid rate. They reduce capital expenditure on hardware and upgrades. They also help you cope with the changing demands. One can easily scale their cloud infrastructure based on the service demand. If your needs increase it's easy to scale up your cloud capacity, drawing on the service's remote servers. Likewise, if you need to scale down again, the flexibility is baked into the service. This level of agility can give businesses using cloud computing a real advantage over competitors and is making cloud hosting platforms an attractive option over hosting an in-house server rack. Cloud platforms these days have become more secure than ever before. They implement advanced security measures ensuring data integrity and preventing a data breach. With many cloud platforms providers like IBM's Bluemix, Amazon's AWS around, users can now have an option to choose a platform which they feel are more reliable and cost-efficient for their bots.

As per the article published on 451Research, *"Virtual assistants, bots and conversational software interfaces are sending the world's largest tech companies hunting for natural-language-processing (NLP) technologies and expertise"*. Attempts are being made to develop models which could understand natural language of human to gauge their needs. This helps machines to both interpret input and produce output in the form of human language. IBM, Facebook, Google, and Amazon are all making attempts to improve their NLP venture to gain a competitive edge over their competitors. Every day, attempts are being made to improve the accuracy of the NLP algorithm to closely mimic human thinking. With such available tool, bot developer could now engage users into a much insightful talk.

Tech companies are providing frameworks which facilitate the creation of chatbots for different channels. Gupshup, one of the world's largest Enterprise messaging platform is being used by leading companies such as Flipkart, OLA, Facebook to develop chatbots for customer engagement and retention. Gupshup's platform handles on an average of 150 billion messages in total per day. It also provides NLP support and full lifecycle development for their bot service. The growing popularity of chatbot framework platform like Gupshup projects solidifies the potential that chatbots hold for the future.

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Chapter 2. Project Justification

Gartner predicted that by 2020, the average person will interact more with bots than with their spouses and that 85% of customer relationships with the companies will be managed by chatbots. A Chatbot is a software developed to complete a transaction by communicating with other entity using a predefined set of questions and answers. It is the support of technologies like artificial intelligence, machine learning and natural language processing because of which chatbots are now becoming even more humanlike or maybe be even better. Enterprises are investing a fair amount of their resources and time in trying to incorporate chatbots in their existing system to help them reduce the inflow of customer requests that can be handled by a chatbot. Chatbots help the enterprises to drastically cut their labor costs. A report released by Juniper states that by 2022 chatbots will be saving $8 billion per annum of labor costs. JPMorgan Chase, a bank that has a chatbot to help them with their back-office operations has saved them 360,000 human hours. Uber and Lyft have a chatbot that can book a cab using a conversation, this chatbot can replace their mobile application which means less application maintenance for them once most of their customers start using chatbot.

Enterprises develop their chatbot for a specific need that will serve their purpose. Chatbots are being used in different use cases; healthcare industry, customer support, e-commerce, HR systems. To develop a chatbot from scratch with a fair amount of customization could cost a company $40K-$100K and will take 2-3 months of time, that followed by the infrastructure maintenance cost which could be a few thousand dollars per month. It is highly unlikely for a small enterprise to develop a chatbot from scratch. Mid-sized or small enterprises usually either consult software companies or use online subscription-based services. Companies like Google, Facebook and IBM have invested a lot of resources in researching the fields of artificial intelligence and natural language processing. They offer conversation services (APIs) that can be easily used by chatbot to derive intents from the conversations, this saves the enterprises from investing a lot of time and cost for researching and developing their own in-house conversation service. A channel is a medium through which a user can interact with chatbot; Facebook messenger, Slack, Kik or even their own chat application. These channels also can easily be used by the chatbot with minimal configuration changes.

To address the issue of high cost of development and maintenance of chatbots we are proposing a chatbot framework that will drastically reduce the cost and the time required in the process. This framework will provide the user with a choice of using a channel, a conversation service and a cloud platform to deploy the chatbot from amongst the best in the industry. The framework will provide templates to the user that needs a minimal amount of changes. The user will also be provided with a personalized dashboard which will show all the information about the user’s currently and previously owned bots with versioning support. The dashboard will also provide analytics about the usage; conversation traffic, average time of conversation, uptime and downtime. The user will also have access to the detailed report on failed conversations that can be used to further train the bot and avoid any failures in the future.

Chapter 3. Project Requirements

Use Cases

1. As a framework user, I want to be able to maintain the history of my chatbots and their version history.

2. As a framework user, I want to be able to have a choice to select the suitable channel for my chatbot.

3. As a framework user, I want to be able to have a choice to select the suitable conversation service for my chatbot and integrate it with ease.

4. As a framework user, I want to be able to have a choice to select the cloud platform to deploy my chatbot.

5. As a framework user, I want to be able to have a detailed view of the statistics of my current as well as old chatbots.

6. As a framework user, I want to be able to see the failed conversations with the details about the chat, by using this information I should be able to train the chatbot to handle failed conversations by configuring relevant intents.

7. As a framework user, I should be able to change the channel, cloud platform or the conversation service with minimal configuration changes.

8. As a framework user, I should be able to deploy a selected version of my chatbot at a press of a button.

Functional Requirements

Req No.	Requirement Description	Type
Req 1	Framework should be able to create and maintain user profile	Essential
Req 2	The system should be able to maintain the history of the bots and the changes made to them by the user.	Essential
Req 3	The system should be able to display a dashboard with details of the chatbots owned by the user.	Essential
Req 4	The system should be able to provide a choice of conversation service (NLP/AI/ML) API user wants to use for a chatbot.	Essential
Req 5	The system should be able to provide a choice of channel user wants to use for a chatbot.	Desired
Req 6	The system should be able to provide a choice of cloud platform user wants to use for deploying a chatbot.	Optional
Req 7	The system should provide the user with the detailed report on the chatbot's failed conversations.	Essential
Req 8	The system should be able to provide detailed statistical analysis about the active chatbots of the user with many conversations, uptime, downtime, the average time of the conversations.	Desired
Req 9	The system should send the user notifications if there's a sudden increase of load or increased rate of failures.	Optional

Non-functional Requirements

Req No.	Requirement Description	Type
Req 1	The system should be able to scale easily as per the user's requirements.	Essential
Req 2	The system should be able to maintain high availability.	Essential
Req 3	The system should provide instructions to the new user when using the application.	Optional
Req 4	The system should use a data replication to have a backup of data during a system failure.	Desired
Req 5	The system should encrypt user's data before storing the data into the database ensuring the security.	Optional
Req 6	The system should generate detailed logs that will help to debug.	Essential
Req 7	The system should have at least 90% of test coverage.	Desired

Chapter 4. Dependencies and Deliverables

Dependencies

1. Integration support provided by the 3rd party service providers of messaging channels and conversation services.
2. Accessibility of the user's data.
3. The format of the user's data, it should be available to the framework in the JSON format.
4. Framework's availability and performance of the system will be directly impacted by that of the integrated external services.

Deliverables

1. Framework as a service accessible to the users to create and maintain chatbots.
2. A web interface to the user with a dashboard providing information of the user owned chatbots.
3. System generated statistical reports on chatbot's performance and failures.
4. Notification service for the user for an unusual change in chatbot's performance or incoming traffic.
5. Test cases.
6. Project documentation and user manual.
7. UI mockups and wireframes.

Chapter 5. Project Architecture

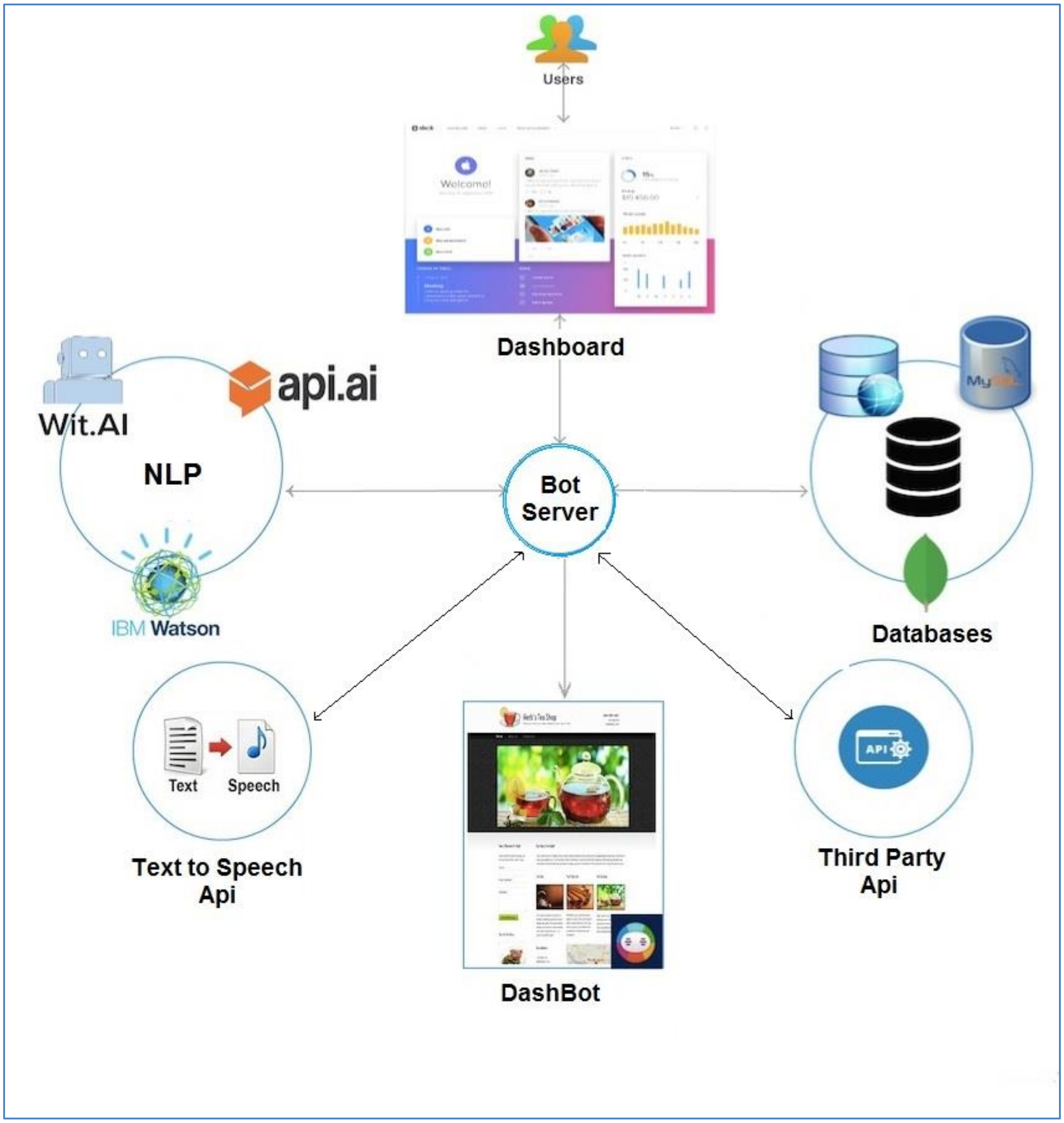


Fig. 5.1 System Architecture

1. **Database**: This is the customer's database which can be queried to complete business transactions. Depending on the output from the NLP after processing the user’s input, the database will be queried to fetch the data for the response.

2. **NLP:** This is a set of conversation APIs that are available to the developer for processing user chat. Depending on the relative performance and features offered by an NLP platform, the developer can make a choice from a set of available options.

3. **Text to speech API:** API to convert text to speech and vice versa. For example, Google’s Cloud Speech API.

4. **Third party API:** The framework facilitates integration any third-party API which the developer can rely on for formulating the chatbot’s response. For example, if a developer wants to include a real-time weather information as an intent to be handled by the chatbot, any third-party weather API could be easily integrated.

5. **Bot Server:** A cloud server platform for chatbot hosting; IBM, Amazon or Heroku Pass. This is where the operational logic for the chatbot would be hosted.

Chapter 8. Implementation Plan and Progress

Environment setup

Action	Tools/IDE	Assigned to	Status
Setting up MEAN stack	MongoDB, ExpressJS, AngularJS/ReactJS, Nodejs	Aditi, Nachiket	Done
Setting up IDE	Webstorm	Aditi, Nachiket	Done
Setting up Cloud Logins	Putty	Abhishek, Sushant	Done
Setting up NLP platform accounts	Api.ai, Wit.ai, Watson	Abhishek, Nachiket, Sushant	Done
Cloud Environment Setup	Amazon AWS/ IBM Bluemix	Abhishek, Sushant	Planned

Development and Testing tools

Tools/IDEs	Status
Webstorm	Done
Postman	Done
Amazon AWS/ IBM Bluemix	Planned
Apache JMeter	Planned

Code Samples

Implementation	**Tool/IDE/Platform**	**Assigned to**	**Status**
Implementing sample MEAN stack project	MongoDB, Express, AngularJS/ReactJS, Nodejs	Aditi, Nachiket	Done
Connecting bots to messaging channels like Facebook, Slack.	Facebook messaging API, Slack bot API	Abhishek, Sushant	Done
Deploying bots to cloud platforms	Amazon AWS/ IBM Bluemix	Abhishek, Sushant	Planned
Experimenting with NLP services to link Chabot.	Api.ai, Wit.ai and Watson	Abhishek, Aditi, Sushant, Nachiket	Planned
Creating a working model of a Dashbot.	MongoDB, ExpressJS, AngularJS/ReactJS, Nodejs	Aditi, Nachiket	Planned

Project feature Implementation

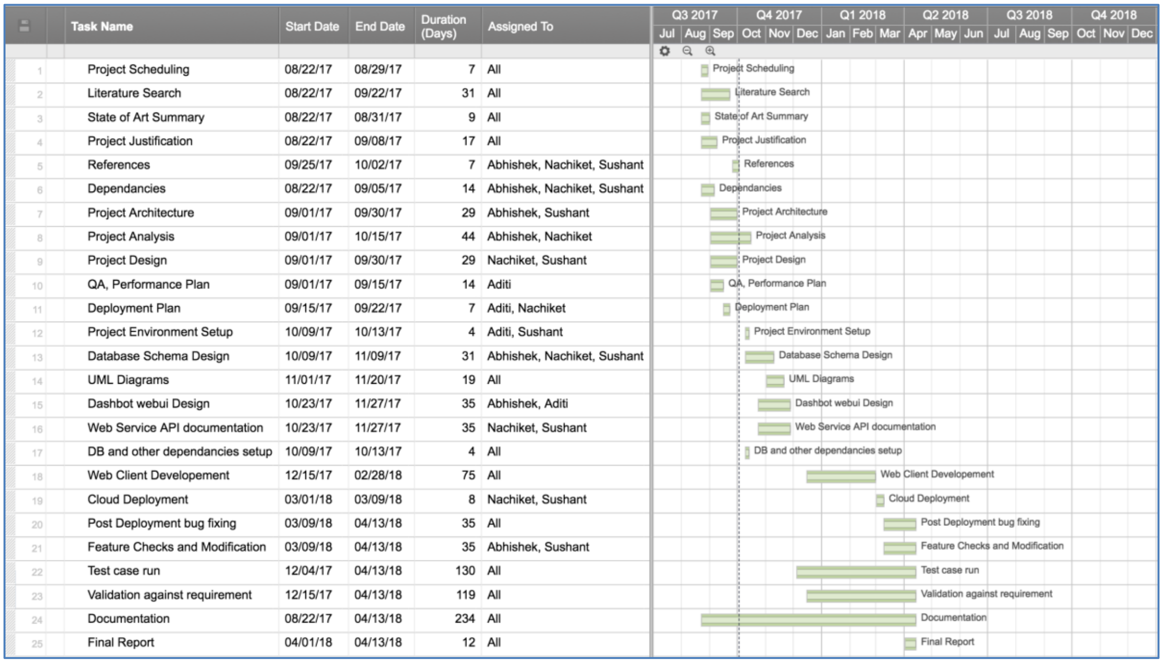
Features	**Status**
Creating a centralized management portal for managing Chatbots for all users.	Planned
Implementing login functionality to maintain user accounts.	Planned
Maintaining a history to the various Chatbot versions developed by the user.	Planned
Developing a generic bot template in NodeJS which would include the basic housekeeping code required for the health status checkup and linking to third-party APIs.	Planned
Establishing the connection between the central management portal and the cloud service providers to enable one-click deployment of the developed bots.	Planned
Implementing a generic UI chat template with data traffic control logic for the dashbots. The user can easily deploy this interface onto their website and control its behavior from the framework.	Planned
Providing an easy to plug interface where a developer can experiment with different NPL services supported by the framework.	Planned
Providing an easy to plug interface where a developer can link database and the bot.	Planned
Implementing an interface that would enable the developers to train the chosen NLP model by creating a mapping between the likely questions that a user would ask and intents that the bot should understand.	Planned

Performance testing and quality assurance

Performance Factor	**Status**
Performing load test on the framework using JMeter to determine the number of simultaneous users that the framework can support and scale up the infrastructure according to the demand.	Planned
Writing unit test case.	Planned
Writing database cleanup and optimization scripts to improve framework performance in user account management.	Planned
Implementing an admin dashboard which would provide the summary of the availability status of all the services that are being utilized by the users for their Chatbots.	Planned

Chapter 9. Project Schedule

Gantt Chart



	Task Name	Start Date	End Date	Duration (Days)	Assigned To
1	Project Scheduling	08/22/17	08/29/17	7	All
2	Literature Search	08/22/17	09/22/17	31	All
3	State of Art Summary	08/22/17	08/31/17	9	All
4	Project Justification	08/22/17	09/08/17	17	All
5	References	09/25/17	10/02/17	7	Abhishek, Nachiket, Sushant
6	Dependancies	08/22/17	09/05/17	14	Abhishek, Nachiket, Sushant
7	Project Architecture	09/01/17	09/30/17	29	Abhishek, Sushant
8	Project Analysis	09/01/17	10/15/17	44	Abhishek, Nachiket
9	Project Design	09/01/17	09/30/17	29	Nachiket, Sushant
10	QA, Performance Plan	09/01/17	09/15/17	14	Aditi
11	Deployment Plan	09/15/17	09/22/17	7	Aditi, Nachiket
12	Project Environment Setup	10/09/17	10/13/17	4	Aditi, Sushant
13	Database Schema Design	10/09/17	11/09/17	31	Abhishek, Nachiket, Sushant
14	UML Diagrams	11/01/17	11/20/17	19	All
15	Dashbot webui Design	10/23/17	11/27/17	35	Abhishek, Aditi
16	Web Service API documentation	10/23/17	11/27/17	35	Nachiket, Sushant
17	DB and other dependancies setup	10/09/17	10/13/17	4	All
18	Web Client Developement	12/15/17	02/28/18	75	All
19	Cloud Deployment	03/01/18	03/09/18	8	Nachiket, Sushant
20	Post Deployment bug fixing	03/09/18	04/13/18	35	All
21	Feature Checks and Modification	03/09/18	04/13/18	35	Abhishek, Sushant
22	Test case run	12/04/17	04/13/18	130	All
23	Validation against requirement	12/15/17	04/13/18	119	All
24	Documentation	08/22/17	04/13/18	234	All
25	Final Report	04/01/18	04/13/18	12	All

Fig 9.1 Gantt Chart

Pert Chart

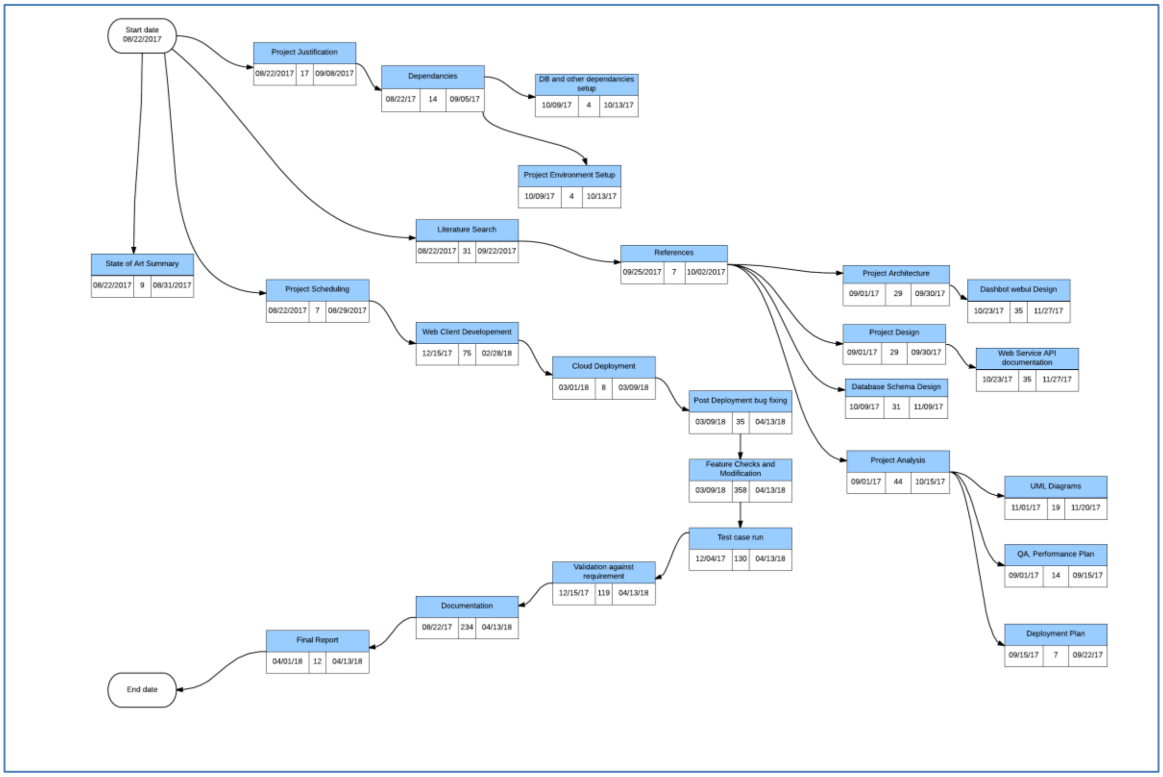


Fig 9.2 Pert Chart