Group ID:
Team Members: MD ENAMUL HAQUE SUMON (18736813), MUHIB HASSAN KHAN (18742914)

CSE5 ITP Application Development

Final Report

Project Title: Ambulance Arrival Time

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1 Overview

Need for project
One of the most important factor for a hospital is to handle the emergency section well. There is always an ambulance arriving with patient in critical condition often required to be assessed with proper treatment. Otherwise their life might be under serious threat. In those cases, the importance of a software system that can let the emergency section know when the next ambulance's estimated time of arrival; which is very crucial for the staffs to get prepared to treat the patient as soon as possible.

Challenges
Big projects like this comes with broader challenges. Some of the major challenges in this project during the build was

- To get the data from various sources to predict the ETA
- Considering all the possible aspects that can play a part on the above matter
- Get the work done in the limited and challenging time frame
- Limited resource and man power
- Generate an acceptable system in the given time-frame

Opportunities

1.1 Project Objectives

The main objectives of the project are

- Build an ETA generating system
- Collect enough training data to test the system
- Build a machine learning model
- Build a predictive analysis model
- Upload file system to store the data
- Generate report on a timely basis

1.2 Project Constraints

Major constraints of this project were

- Collecting enough training data to train the machine learning model and get a better result from the predictive analysis
- Not enough data to predict the siren/lights on/off ETA
- Not enough time to complete a broad project like this
- Not enough resources to produce a better system
- Not enough man power to work and complete the project in a better way

1.3 Project Risks

Event Risk	Risk Probability	Risk Impact	Risk Mitigation	Contingency Plan
Project Size				
Number of hours per person (20 hours a week, total 10 weeks working time on the project)	High: Over 200	Will affect the project delivery time	Additional extra hours worked during the weekdays	Re-consider the project backlog and sprint management
Project Delivery Time	High: Over 14 weeks	Will affect the deliverable product in the mean time	Additional team members added	Deliver the deliverable product completed and tested
Project Definition				
Required knowledge of the team members	High: Only the background basics are understood, less technical knowledge	Will affect the project deliverable	Additional sessions are taken over the project base knowledge required	More research and additional working hours to be implemented
Cost estimation unclear	High: More investment needed	Will affect the deliverable project efficiency	Increase the budget and sign sponsors	Use the current tools available on the given budget and build deliverables accordingly
Time estimation unrealistic	High: More time required to generate an efficient and effective system	Will affect the effectivity and efficiency of the deliverables	Extend the project time to a more realistic time-frame	Build project given limited resources available and test on them
Project Leadership				
Commitment/Attitude towards the project	Low: Good understanding of the project values and support for the project	Will affect the project outcome	Regular feedback meetings to ensure project understanding and enthusiasm	More sessions with the team mates and the project mentors to generate more energy
Project Team-members				
Team members work places	High: Team members work from different locations	Will affect the communication between the team members	Use online websites to keep the team members	Team members can gather and work together on an agreed time

			updated about the work progress	and place
Lack of understanding of the software or tools to be used	Medium: Only has conceptual knowledge in most cases but good skills in some software	Likely to affect the project outcome	Get more knowledge based on the project required software or tools	Use the most used tools for the moment even if it is less efficient

2 Proposed Solution

- Gather data from sources
- Create a user interface for the user to upload data files
- Build a model to store data for machine learning
- Organize data for data analytics
- Build a model to run predictive analytics on the stored data
- Build a model to generate predictive analytics report
- Create a system for the user to see real time ETA predictions

2.1 Business Requirements

Evaluate existing processes
A meeting with client was held to understand the project in detail and in depth. User story was then analyzed to generate project requirements. Further meetings with the clients of different sectors on the organization will provide more information on that.

Define new business rules and workflow
Change to the current system of monitoring ambulances' arrival will be changed from the current software to this new cloud based system. The workflow will be changed as well as the new system works differently than the older system and do not require much human interaction.

Define specific User Interface (UI) requirements
- Secure login/sign up system
- Simple UI for the staff – easy to train
- Easily understandable and recognizable functions
- User friendly design and font
- User friendly Map system and ETA system

Define specific technology requirements
- High speed internet
- Good computer systems
- GPS system
- Local server system with strong storage

2.2 Architecture

Functional Specifications

The overall system behavior is as follows.

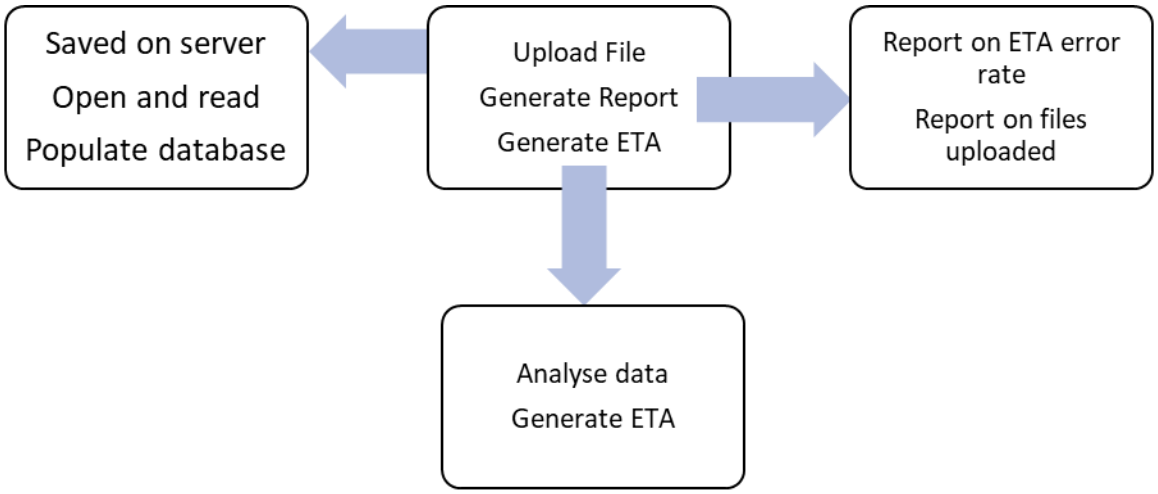

Figure 1 System Behavior

The high-level view or architecture consists of 5 major components:

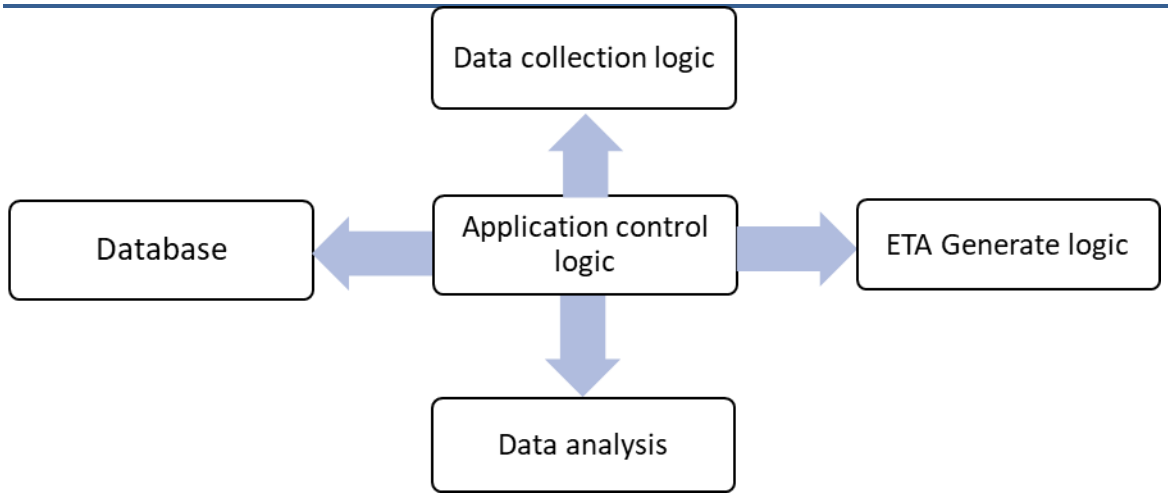

Figure 2 System Architecture

- The **Data Collection logic** is the controller for data collection and manipulation.
- The **Database** is a central repository for data on time estimation and way points.
- The **ETA Generate logic** is the function to generate ETA based on the data provided for the given route and time.

- The **Application Control Logic** is the main driver of the application. It presents information to the user and reacts to user inputs.

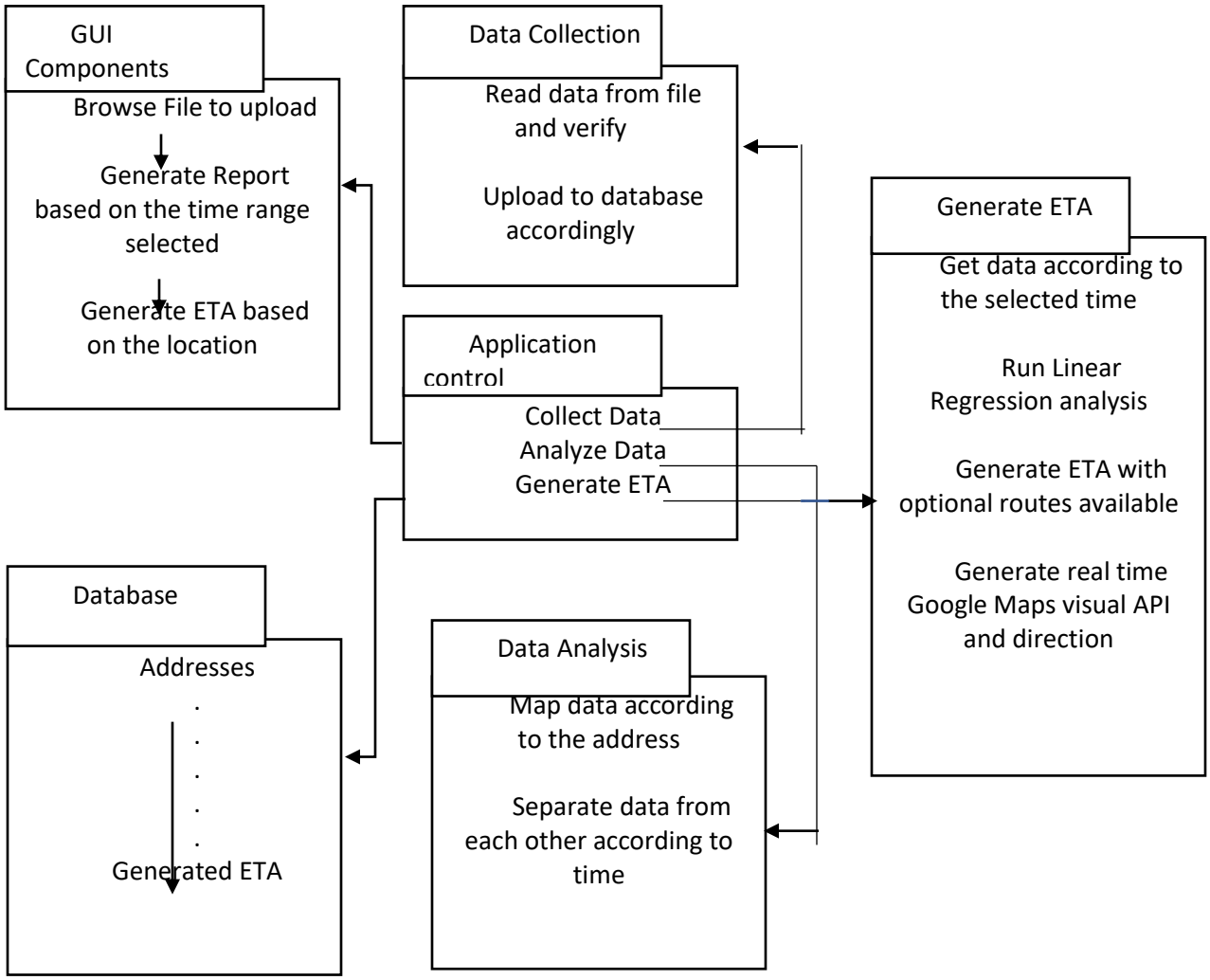

Figure 3 Mid-Level design components and their relationships

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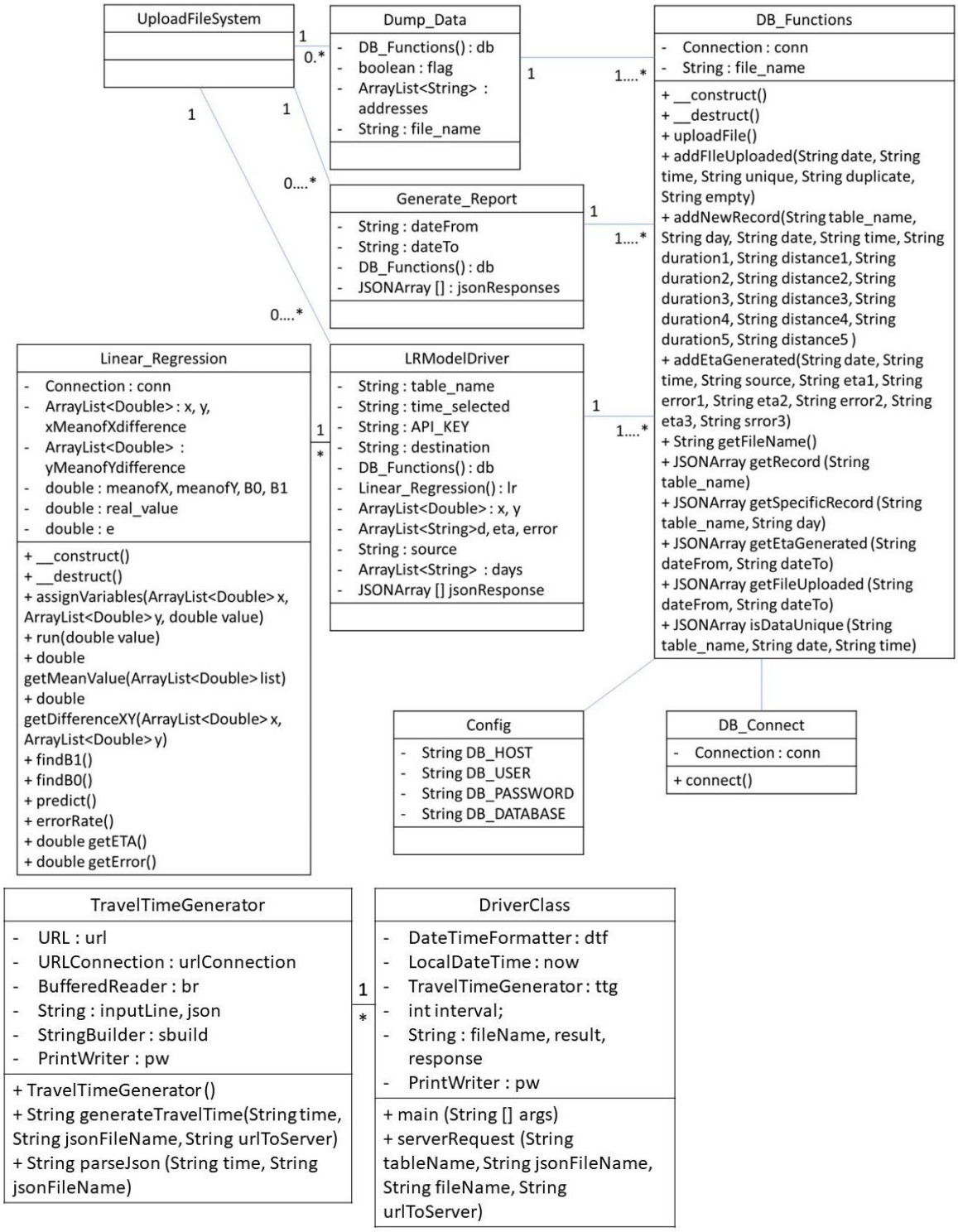
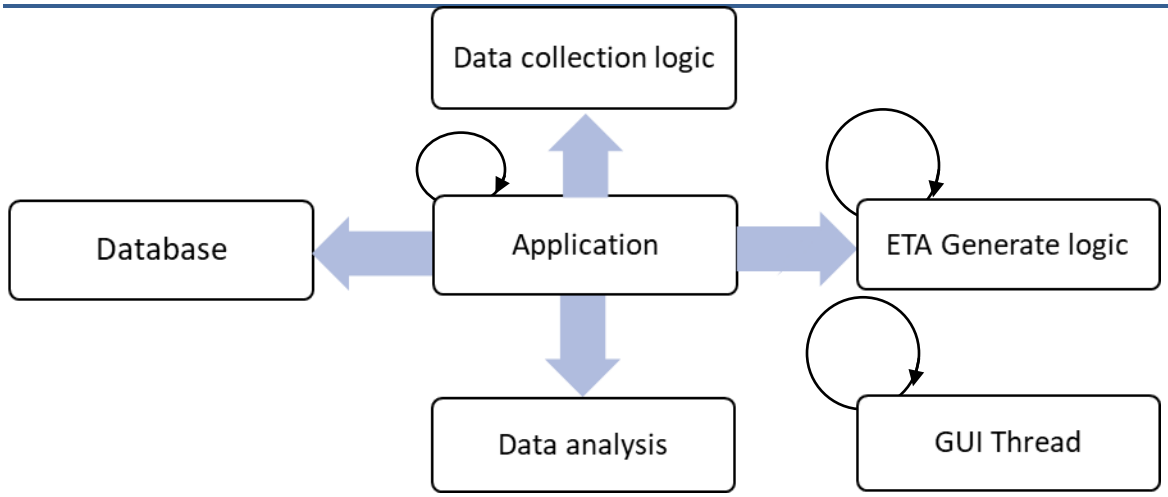
Class diagram as follows



Process view as follows. Each loop represents a thread of control.



Technical Specifications

- Network specifications
  - Internet connection required to run this system
- Platform specifications
  - Computer system - Windows OS
  - Server – Linux
  - Database – MongoDB, MySQL
- Development languages
  - System – Java
  - Web page – PHP, HTML
- Peripheral specifications
  - A browser to display the web page

Security Specifications

Network Security
Least firewall security is required to secure the data. End to end encryption is costly hence not considered initially. But might be provided in future. The system will run under the hospital's network. The hospital should ensure a well-organized web security system is maintained. The ambulances will use a sim-card to have internet in them. The devices will run android and connect with the server to generate the ambulance's current position. Do not required extra security than usual.

Web System Security
A log-in required with the id and password for the staff that has authority to upload files in the server
A log-in required for the staff to see the incoming ambulances and their ETA

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2.3 Development

Project Sprints

Sprint 1 – Collect training data and testing
Sprint 2 – Build a machine learning model
Sprint 3 – Build a predictive analysis model
Sprint 4 – Build display system and generate report
Sprint 5 – Assembly and testing
Sprint 6 - Documentation

2.4 Testing

Features	Testing Method	Team Member Responsible
Login/Sign-up	White Box	Md Enamul
	Black Box	Muhib
Training data collection	White Box	Md Enamul
	Black Box	Muhib
File upload system	White Box	Md Enamul
	Black Box	Muhib
Generate ETA System	White Box	Md Enamul
	Black Box	Muhib
Generate report system	White Box	Md Enamul
	Black Box	Muhib

2.5 Deployment

Major Milestones

First Milestone

- Collect enough data to test the predictive analysis system

Second Milestone

- Build the predictive analysis model

Third Milestone

- Build a web application system

Fourth Milestone

- Build a login/sign up system

Fifth Milestone

- Assembly and documentation

3 Project Resources

3.1 Roles and Responsibilities

#	Roles & Responsibilities	Team Member	Level of Authority
1.	Research on the APIs available to collect data	1. Muhib 2. Md Enamul	Conduct Approve
2.	Build API based on the selected API and start collect data	1. Md Enamul 2. Muhib	Conduct, Approve Support
3.	Design a database entity diagram to store collected data	1. Muhib 2. Md Enamul	Conduct, Approve Support, Approve
4.	Research on the current machine learning models and predictive algorithms	1. Muhib 2. Md Enamul	Approve, Support Support
5.	Design a UML to build the predictive analytics model	1. Muhib 2. Md Enamul	Conduct Support, Approve
6.	Build a model for predictive analytics based on the UML	1. Md Enamul 2. Muhib	Conduct, Approve Support
7.	Build a web based system for file uploading	1. Muhib 2. Md Enamul	Conduct Support, Approve
8.	Build a web based system to display the ambulance ETA	1. Muhib 2. Md Enamul	Conduct Support, Approve

3.2 Project Staffing Plan

Role	Detailed Description	Skill Required
Project management and planning	• Manage the whole project • Plan the project structure and resources required	• Communication • Leadership • Team management • Negotiation • Personal organization • Risk management
System Design	• Design the whole system architecture that will work as the blue print	• Broad knowledge of hardware, software, programming • Problem solving approach • Team effort
Business and technical analysis	• Analyze the project as a whole and its outcome	• Critical thinking • Problem solving • Communication

		• Specification • Documentation
Programming	• Programmers to build the system according to the design	• Programming • Problem solving • Critical thinking • Active learning • Active listening • Operational analysis
Testing	• To test each sprint as it is coded • Test each part as well as the whole system	• Analytical and logical thinking • Curiosity and creativity • Global + Local approach • Critical thinking • Rational approach • Basic and fundamental knowledge
Documentation	• Will document the whole project	• Technical documentation • Risk management • Customer and client management

Resource Breakdown

Tools and Resources	Estimated Cost
Domain	$12.00 (annually)
Hosting	$6.00 (monthly)
Database – MySQL	Free
Database – MongoDB	Free (500 mb)
Google Maps API	Free (2,500 requests per day)
NetBeans	Free
Notepad++	Free
Microsoft Office	Free (Student copy)
Computers	NA (team members have personal computers)
Team member salary	NA

Issue Escalation

Issue (Probable)	Action
Changes in specifications	Meeting will be held with customer with the acknowledgement of the changes and time remaining
Short in team member	More team members will be hired to complete the project in time
Coming short to deadline	Team members have to work overtime to

	complete the project in the estimated time
Underestimation of a specification	Will be discussed, and a meeting will be held with the client to resolve the issue
Overestimation of a specification	Will be discussed, and a meeting will be held with the client to resolve the issue

3.3 Project Materials

Hardware Materials

- Computer
- Server hosting

Physical Networking Infrastructure

- Router for Wi-Fi connection or physical cable connection

Co-location Space

- Selected routes to the hospital for real time testing

Licensing

- Google – to use Google maps API
- MongoDB – to use database resources
- Domain – to register a domain
- Hosting – to use remote shared hosting
- Microsoft Office – to read and write data and documentation

4 Project Approach

4.1 Development Model

Agile development methodologies will be followed to build this project. Following are the stages and deliverables during different phases

First Stage
Develop an API for data collection. Develop a database structure to store collected data remotely.

Second phase
Build a model to run predictive analytics. Using the predictive analytics model the user uploaded file will be analyzed and a report will be generated. The web page based system to upload files will be delivered in this phase.

Third Phase
Build a web based system to display the real-time trial of the incoming ambulances. A web system will be delivered at this stage.

4.2 Configuration Management

Components

- Build project baseline
  - The first sprint should be delivered within the first 3 weeks
  - The second sprint should be delivered within the 5th week of the project
  - The third sprint should be deliverable up to the 10th week
  - The fourth sprint should be deliverable by the 12th week
  - The fifth and final sprint should be deliverable by the 14th week
- Implement code library system
  - The code should be organized using the GIT. All the source code to be uploaded to GIT for reference
- Track changes in project baseline
  - Constantly track the baseline if any changes in the project scopes are made
  - Baseline will be updated accordingly all the time

Tools

Project management tools Trello is used to execute the configuration management processes.
GIT is used to store source code as a central assembly of the codes for the project

Reporting

- Change History
  - Any changes made are recorded in the history
- Release status reports
  - Release statuses will be reported accordingly
- Project Baseline analysis reports
  - Baseline will be analyzed constantly with further update

4.3 Communication Management

- A scrum meeting will be held once in every week to report project progress
- Team members should be available during working hours (9:00 am to 5:00 pm) to be able to communicate with each other regarding the project
- If a member is sick or ill he/she will report as soon as possible so that his task can be redistributed
- A meeting with the client will be held during the course of the project. That can be more than once upon required
- Meeting with the supervisors will be held every once in a week

4.4 Change Management

- Name of change initiator
  - Md Enamul Haque Sumon will be the change initiator
- Documentation regarding the nature of the change
  - Documentation will be recorded over the changes and adjusted accordingly
- Change impact analysis
  - Change in the impact analysis will be done
- Change rejection / approval
  - Change status accordingly

4.5 Testing

Project Role	**Resource Requirements for Testing**	**Schedule**
Data to be collected correctly and database design	A team member will verify the data collected are in the given format and remove any unnecessary lines from it. Database design will be checked thoroughly to ensure it will not require further changes in future	First Milestone
The web system is able to upload files by user and Predictive analytics model is ready to generate report	The algorithm to build the Predictive analytics model will be tested thoroughly. Any bug should be fixed. The data uploading should be successful and within the limitation of storage with proper exceptions declared to the user	Second Milestone
The web system should be able to display the incoming ambulances and their arrival time correctly	Team members will assess this test with the collected data. The accuracy will be monitored with the increasing amount of data over the time.	Third Milestone
The project is ready to be delivered	Team members will test the project thoroughly several times before a final delivery. All constrains will be tested and the system will be tested for real time situations with bulk amount of incoming data traffic.	Fourth Milestone

4.6 Documentation

- Both physical media format and electronic format will be delivered
- Documentation will be delivered after each milestone reached with the product deliverables
- A final review document will be delivered to review and adjust before the final document is delivered

5 Estimate

Sprint	To be Completed
Data collection	From week 3 - 12
Build a machine learning model and testing	From week 4 - 5
Build a predictive analysis model and testing	From week 6 - 10
Build a web application system and generate report and testing	From week 11 - 13
Assembly and testing	Week 14

6 Schedule

Priority	Task	Schedule (Deadline)	Resource
1	Build a data collection model	31-08-2017	Java, Google Maps API
2	Continue collecting data	27-10-2017	Workstation
3	Research on predictive analysis algorithms	13-09-2017	Internet, Library, Books, eBooks
4	Build a predictive analysis model	1-10-2017	Java, PHP, Tomcat, Servlet, MySqli
5	Build a web application system	14-10-2017	PHP, HTML
6	Test the system	24-10-2017	
7	Documentation and Report	6-11-2017	Microsoft Word, Adobe PDF Reader

7 Project Success

Requirements Achieved	Review
Project delivered on time	The project was delivered on time
Generate ETA - system	The ETA generation system worked to an acceptable condition. It successfully generates the desired ETA with an error rate of around 1~2 minutes largely due to the short collection of data. Expected to improve over the time with more data

	analysis.
File Upload – system	Works fine with text files and correctly formatted files. File uploads quickly to the server then reads to the database with effect.
Generate Report – system	Generate reports successfully to the requirements.
User friendly environment	System is user friendly enough for the staffs to acquire quickly and hold a grip of the system within a short time
Documentation	Full documentation of the system is provided as required with every details.

8 Unexpected Events

Events	Impacts	Actions Taken
Underestimation of time schedule	Some deliverables were delayed	Over time working of the team members to reach milestones
Underestimation of number of team members required	Overall project took more overtime than actually expected to reach an acceptable outcome	Team members worked overtime and after hours during the weekdays and weekends to meet deliverables.

9 Lesson Learned

Description	Recommendation
The overall time estimate was not feasible	2-4 weeks more would have produced a better outcome
Shortcomings of team members	1-2 more team members would have helped and take some workload of the current team members
More modern technology would have helped	Using more modern technology might have made the project more versatile

10 Future Aspects

Current System	Future Improvement
Only accepts .txt files	.xlsx, .csv, .dat, .xml, .json
16 addresses were used to test	more coordinates and more routes

Siren/lights on estimated	More accurate data from real time GPS results
No ambulance assistance for the driver	Small mobile device for the driver to • Choose nearby hospital • Enter patient's condition
Only generates limited report	More analytic report to improve the overall system and more machine learning to improve the system itself