# Chapter 10: Conclusion

## 10.1 Chapter Overview

This chapter will inform about the entire research by highlighting the aims and objectives that the author has identified during the research process. Moreover, will be discussing the new and improvement skills applied to implement the proposed system along with its learning outcomes, challenges as well as problems faced throughout the period. At the end, according to the author would discuss the limitation, future enhancement could be done to improve this proposed thesis.

## 10.2 Achievement of Research Aim and Objectives

## 10.2.1 Achievement of Aims

*The aim of the research is to design, develop and evaluate a recommendation system that would help individual to beware of the approximate salary that an individual would acquire based on their few characteristics, hence by knowing will be able to overcome salary discrimination because the individual will have some kind of knowledge about the salary they would gain.*

The aim of the research project was successfully achieved by designing, developing as well as evaluating the recommendations architecture to overcome salary discrimination in the organizations and resolve few recommendation problems.

## 10.2.2 Achievement of Objectives

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| Objective | Description | Status |
| Problem Identification | Critically analyzing the problem in domain such as the financial sector as well as the recommendation system problems. | Completed |
| Literature Survey | Critically analyzing the possible similar/existing works accordance to the domain selected | Completed |
| Requirement Elicitation | Discussions and critically analyzing the user requirements and will it be useful in the industry. | Completed |
| Design | Designation of the Salary recommendation system for with UI/UX guidelines | Completed |
| Development | Development of the proposed systems prototype such as the Machine learning, backend server and frontend software | Completed |
| Testing and Evaluation | Testing the prototype if it’s feasible for the end users and evaluating the project with important metrics. | Completed |
| Documenting the progress of the research | Structuring the documentation of the thesis and showing the progress to the supervisor. | Completed |
| Publish finding | Publishing a research paper since a salary recommendation system has not been done, according to the study of the author. | Incomplete |

## 10.3 Utilization of Knowledge from the course

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| Module | Description |
| Programming Principle one and two. | This module was a kick start to learn basic programming languages, the author was able to learn about python language and its benefits. |
| Object-oriented Programming (OOP) | This was one of the main concepts and very much helpful to build software in a structured manner both in personal software as well as in the industry. |
| Software Development Group Project (SDGP) | In this module the author was able to make a proper monolithic project that thought on how to build software in an industry level and helped to improve the documentation skills. |
| Database System | With the aid of this module, the author was able to grasp the fundamentals of writing SQL queries and using databases to store data for the project. |
| Algorithms: Theory Design and Implementation | The knowledge gained in this module was very important, since it helped to properly analyze and design algorithms with high performance. |
| Web Design and Development | The author was able to learn basic knowledge and build Frontend Application with UI/UX guidelines by using HTML, CSS as well JavaScript. |

## 10.4 Use of Existing skills

Throughout this degree program the author was able to gain several skills which were very useful when developing the proposed system. The gain skilled are listed below:

**Python:** The author had a prior experience in python language since during the SDGP author fully worked in this language. The author learned about the language by watching videos on YouTube as well as using LinkedIn Learning. As result due to this prior knowledge it helped the author to implement the Backend implementation in flask framework.

**Database (NoSql):** These existing skills help the author to make use of database to structure as well as store the new salary informationby using PostgreSQL.

**Industrial placement skills:** The author successfully completed as full-time java backend developer in Digiratina Technology Solution. Also, the author was involved in designing databases and helping the co-worker in implementation process, plus reviewing the codes of co-workers.

## 10.5 Use of new skills

**Recommendation system** – The author has never worked on a recommendation system or another machine learning module, hence this was an added skill plus an advantage for the author on to learn new scope apart from known knowledge. The author learned recommendation systems by watching videos and doing sample projects with the help of online platforms such as Coursera and Udemy.

**React JS** – Even though the author had a little bit of understanding in JavaScript, due to full time working as a backend end developer during the industrial period, author had to learn react JS as well to implement the Frontend for the proposed system, this was learned through watching YouTube videos and reading the react official documentation.

**Docker** – Docker was learnt by the author to deploy the proposed system both the backend and frontend, but at the end the author was not able to deploy the project, but still the skill was still learned with the help of LinkedIn learning.

## 10.6 Achievement of Learning Outcomes

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| What has been learned | Learning Outcome |
| This thesis has helped the author to gain knowledge about the domain that has been worked on through the period | LO4 |
| The author developed time management skills by carefully preparing each project phase. | LO2 |
| Building recommendation system with different kind of classification and recommendation techniques was completely new for the author, which must be learnt during the span of the project timeline. | LO5 |
| The proposed project must be done all by the author, hence all the errors and other functionalities should be solved and researched by the author himself, hence problem-solving skills was learned. | LO5, LO7 |
| By continuous research and self-learn the author was able to identify the technologies that should be used to build the proposed system. Technologies to build the Frontend, backend as well as the Machine Learning algorithm. | LO1 |
| The requirement gathering process was also improved, since formal interviews, prototyping as well as survey techniques was used to gather information and validate if this system is feasible and helpful for upcoming individuals in the IT industry. | LO3 |
| Documentation is a one of essential part, since the author should validate the problem and the research domain that this thesis involves in. hence documentation skills was mandatory as was able to improve. | LO8 |

## 10.7 Problems and Challenge faced.

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| Challenges | Solution |
| Lacking knowledge in required technologies | Since the author was not aware of the Machine Learning techniques and how to implement, the author had to do many self-learning and do sample projects to implement the proposed system. |
| Time constraint | Even though this was yearlong module, the author had other modules as well to focus, but still with the help of time management skills was able to complete the proposed system successfully. |
| Deployment of the project to GCP. | The author faced deployed issue to GCP cloud, since the database connection using SQL Alchemy didn’t work as expected the backend server wasn’t successfully deployed, but the Frontend was able to deploy using GCP, hence the author decided to use the application in the local host server. |

## 10.8 Deviations

The initial goal of the project was also introduce reinforcement learning, since the salary of an individual will be changing over the period of time, hence based on the system whenever the new salary is added the author planned to use reinforcement leaning which would improve the Salary recommendation for the target audience, but due to the time constraints and the effort required to learn about on how to build reinforcement for the particular was not feasible.

Moreover, the author also wanted to use Deep learning to build the recommendation system, due to lack of dataset for Sri Lankan IT industry salary information, was not able train a Deep learning technology hence, used Machine learning as well as recommendation technique to build the system.

In addition, the author also planned to do prediction for future salary, but due to no dataset availability the author was not able to build prediction for the future salary as well.

## 10.9 Limitation of the Research

* **The scope of the project** – The scope of the project was only to build the salary recommendation for Sri Lankan IT industry individual, which could be expanded globally and to different organization sector. The author only considered a few input features which could be expanded based on the geographical locations.
* **System Application** – The system application was designed and implemented only as a website. It would not support mobiles since it has not been responsive to be opened in mobile phones due to limitation of the time to build the project.
* The system is only limited for few Currencies input which would not accept all the possible currency rates across the globe and the output of the Salary will be recommended in Sri Lankan rupees, not in any other salary.

## 10.10 Future enhancement

* Improve the accuracy of the system by using better algorithms, since the author got only 56% maximum with RandomForestClassifier.
* Do reinforcement learning so that the salary will be up to date, since salary would change over a period.
* Work on Salary prediction as well, hence the users will be helpful to make a future forecast.
* Since the salary dataset is only based on Sri Lankan region, it could be diversified across other regions.
* Making sure that the application is available on all sorts of devices, both on websites as well as mobile applications.
* Accepting more input features from the end user such as Reviews about the recommended salary and accepting location or state for better recommendation of salary.

## 10.11 Achievement of the contribution to body of knowledge

According to the author’s research gap, author tried to solve to build a hybrid recommendation system to solve few recommendation problems such as cold start, lack of data problem and many more. And the author wanted to solve the salary discrimination in between employees within an organization in the IT industry, hence author build a hybrid abroad with the help of combining the RandomForestClasssfier and Content based filtering approach to solve the domains that has been selected. Therefore, with this approach and novel implementation the individual will be able to bargain on the salary if they are biased, which would overcome a bit of discrimination in the IT industry market.

In addition to the machine learning model the contribution will be the hybrid system with the Sri Lankan specific dataset of the people in IT industry which has never build by any individual with the combination of these domains.

## 10.12 Concluding Remarks

In this chapter the author concluded the research thesis by evaluating the research gap from getting feedback from the domain and technical expertise as well as by allowing the end users to use the system, and how well it has helped. Moreover, the author also gained new skills and improved the existing skills by implementing the proposed system. In fact, during the time of doing the research thesis, the author faced a few problems, limitations and identifying a proper research gap, hence learnt on how well it must be properly planned and discussed to overcome the problems. Finally, the author was able to gain experience and knowledge both domain wise and technical wise by the help of this project.