Predicting the most important features of post-COVID distance working IT employees through a Neural Network integrated sentiment analysis

CIS7016 - Research Methods for Technology Dissertation

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Introduction

Due to its numerous potential advantages for both organizations and employees, working from home (WFH) has recently become main option for workspace. To determine the impact of working from home, several companies conducted qualitative investigation. Due to limits imposed by the COVID epidemic, this WFH was more readily available (Bao et al., 2022). All software firms have a tendency to utilize WFH as a result; however, this WFH has several benefits and drawbacks that will be explore in this paper. The aim of this article is to predict the most important features of post-COVID distance working Information Technology (IT) employees through a Convolutional Neural Network (CNN) integrated sentiment analysis by considering these parameters employee work life balance, productivity of the project, cyber security issues, resource details and client satisfaction. Due to numerous restrictions brought by COVID pandemic, the workplace environment was completely altered. As a result, businesses that allowed remote workers to continue operating somewhat survived, but those that required employee presence, such as hospitals, mechanical, electronic, or electrical businesses, did not. Organizations decide to make WFH permanent based on government orders because this pandemic has lasted a long time. Later, each firm performed several interviews and surveys to get input from employees and determine the impact of WFH. Analysing employee productivity, well-being and gauging employee involvement in activities has become challenging (Russo et al., 2021).

The COVID-19 pandemic introduced new business practices, necessitating a change in how businesses operate and how their offices contribute to stable, productive, and satisfying job careers (de Lucas Ancillo, del Val Núñez and Gavrila, 2020).The amount of time developers spent on each task had nothing to do with how they felt about themselves, how productive they thought they were, or any other factor (Russo et al., 2021).

The Cyber security issues increased more and more due to work from home. The allotment of resources, such as a WIFI connection, is the cause of this. If an employee utilizes a public internet connection, there is a higher risk of hacking. Many employees tend to make mistakes because they are unaware of the security policies, which increases the risk ratio. Around the world, 81% of businesses encountered cyber threats as white-hat and black-hat hackers took advantage of the epidemic as a better opportunity to infiltrate the systems. 79% of businesses

suffered downtime because of cyber security risks during the busiest season (BusinessWire, 2021).

Aims, Objectives, and Research Questions

Research Aim

The aim for this research is to build an advanced machine learning model which will help to find the employee satisfaction along with finding scope changes of the organizations due to work WFH. Because of the author's personal work-from-home experience, this topic was chosen. The researcher opted to do an in-depth examination because researcher believed that the WFH concept significantly altered human lifestyle. The author also trying to analysis the cyber issues, work life balance, gender-based employee opinions and how productivity varied before and after pandemic.

Objectives

The objective of the research is given below

1. Business agendas in IT organizations during COVID-19.
2. Scope changes in organizations after the pandemic.
3. Analysing the impact of distance working (remote working) in IT organizations.
4. Categorizing the employees based on their designation and note down which department wants work from home, and which are not.
5. Finding gender-based employee work-life balance through sentimental analysis.

Research Questions

- How business agendas changed in IT organizations during COVID-19?
- What are the scope changes in organizations after the pandemic?
- What is the importance of sentimental analysis and how it will be helpful for this study?
- What factors affect the cyber issues?
- How to increase the efficiency of employees during WFH?
- Does WFH increased productivity?

Research Rationale

Corona virus, which unexpectedly transformed everything, the global financial system is nearly shut down. Even if scientists are unable to prevent the development of dangerous viruses, they

should be prepared to lessen their negative effects on society (Donthu and Gustafsson, 2020). Most of the companies can work remotely but because of that organization must face some consequences which will be analysed in this paper. So doing research on impact of COVID on software companies for finding employee satisfaction is more important to maintain employee work-life balance and growth of the company.

Research Contribution

This research helps to build machine learning model for predicting the most important features of post- COVID distance working IT employees through a CNN integrated sentiment analysis and based on that organizations can predict the consequences and emotions when employees working remotely. The results of this study lead the organization to know about the employee emotions and they can predict the future requirements if another pandemic occur. It provides effective and accurate results with various types of algorithms for example regression, classification and image processing are one of the machine learning (ML) algorithms (Kushwaha et al., 2020). Organizations will get to know the key role played by remote working technique due to this pandemic and noted that this new role is the one that will be helpful for the organizations to be in standard way (Gartner, 2020). Understanding the elements and procedures that allow a workplace to change from an inhumane environment into a pleasant place to work is essential for better society and giving purpose to people's job (Michaelson et al., 2014). So, it is clear that the company needs to update their privacy policies for better management. The purpose of including designation field in questionnaires is to find the roles-based people categorization so that which job role want WFH and which don't, can be found easily. According to that the organizations can easily segregate the assignment of the roles in a structured manner.

Literature Review

The process of conducting a literature review entail examining the work of others in their own field and using that as the foundation for data collecting.

Business agendas in IT organizations during COVID-19

The world has been very frightened about COVID-19 and this pandemic changed the environment drastically because of new social and work cultures. There have been strict regulations has been adapted by government as this pandemic end journey no one knows. Here is the happened thing called lockdown where no one stepped out from the door until its emergency. After a brief shutdown of all industries, several IT firms began to embrace the concept of remote labour. However, the idea of WFH has been around for a while, face-to-face engagement at the office is still preferred by most employers. Yet, despite being aware of employee work-life balance, cyber security concerns, and productivity challenges, this pandemic forced employers to pick work from home (Kushwaha et al., 2020).

Many people lost their jobs because of COVID-19 lockdown and many organizations shut down their companies and institutes. Small organizations faced many issues to survive due to security problems and not knowing enough knowledge to make everything safe and secure (Guleria, Neha, 2020).

In the future, many organizations will consider WFH as an essential part of their business strategy. In a limited fashion, the WFH mode aids several enterprises and services in maintaining their operations. Risk is typically characterized by the scope of negative deviations from the expected results in business and organizational studies (Miller, 1992). It is crucial to develop and put into action destabilization management strategies that reduce a company's susceptibility to interruptions (Park et al.2016).

According to research from Euro found, the pandemic caused about 50% of Europeans to work from home (almost half people) up from 12% before the outbreak. Nowadays also same figure is carried out, so the organization ready to adapt WFH even after the pandemic also (Chowdhury et al., 2020).

The organizations adapted new software's to meet the requirements within the deadline and it maintained up to date installation upgrades for the software's. The organizations tried to give multiple online e-learning programs and virtual trainings to gain from the source and to cope up with the new software as they can't meet face-to-face.

Scope changes in organizations after the pandemic

Economic Recession

In 1918 great recession happen same as the present pandemic but there are signs that the present recession could be even more severe than that. Because of COVID many people faced poverty, even government tried their best to achieve to remove or satisfy employee needs but this pandemic made things even worse than expected. Many companies closed their sales because they are unable to overcome the things and after pandemic also the companies are not able to cope up with current market (Smith, 2021).

Small business owners faced lot issues like financial crises, reputation, and resources issue to overcome the pandemic, but they are not up to mark because of their economy. The government should need to help small organizations to overcome the issue and to became normal condition (Davidsson and Gordon 2016; Doern et al. 20190).

The employees won't receive income if the community doesn't work, and they won't be able to meet their basic needs at home if they don't receive income. It will significantly disturb the economic growth of the organization. To combat this, the government hopes to use the Work From Home (WFH) policy to make it simpler for the populace to continue working remotely even when the virus pandemic forces them to stay at home (Cahyono et al., 2020).

Analysing the impact of distance working (remote working or WFH) on employees in IT organizations

During WFH concept organizations faced many problems mainly finding employee satisfaction because the entire work environment is dependent on employees. By using Artificial Intelligence, Logic Programming, and Entropy for Knowledge Representation and Reasoning Ana (2020) developed a methodology to examine the employee behaviour. The data was collected for that research is through questionnaires. It is challenging to judge the employee satisfaction in a straightforward way because it is associated with different emotions (Fernandes et al., 2020).

Ajagbe (2022) proposed an algorithm which finds the employee performance by using 3 different types of machine learning models such as Artificial neural network (ANN), Decision tree and Random forest (RF). After performing the classification task with the help of those three

algorithms the authors concluded that ANN is the best along them with the result of good accuracy. The data was collected from external data set sources called Kaggle. Before applying machine learning models directly to the data set, the authors performed data cleaning and pre-processing for better performance. From the deep analysis they said that Decision tree prediction will be useful for small organizations where the performance of the employees is not critically reviewed. The suitable approach for major corporations where employee performance is closely evaluated is ANN, whereas the best option for medium organizations is RF (Ajagbe, n.d., 2022).

All the employees in the organization need to be prepared the instructions which organizations are going to implement. The organizations are planning carefully to overcome the issues faced by COVID and to increase the productivity in a structured manner with the help of employees (Anon, n.d.).

A data collection and assessment strategy were created and used in a water laboratory to gauge the satisfaction of the employees in the workforce. The collected is pre-processed for performing ML models such ANN, Logic programming and Entropy approach. ANN had given best accuracy for the model (Fernandes et al., 2020). However, this analysis is only performed on small data but the researcher wants to perform Convolution Neural Networks on the collected research survey for better accuracy over ANN. The author will do some extra predictions also like how employee satisfaction after COVID, security issues and which level or age group employees want to be part of distance working process.

By using fuzzy-set qualitative comparative analysis Jun Yu and Yihong examined the five job qualities that were impacted by employee satisfaction when working from home. These include time, the availability of a home workplace, job autonomy, digital social support, and monitoring mechanisms. After several analyses they concluded that suitable work environment at home is the crucial role for better performance of the employee. However, job autonomy is not a prerequisite for employee job happiness (Yu and Wu, 2021).
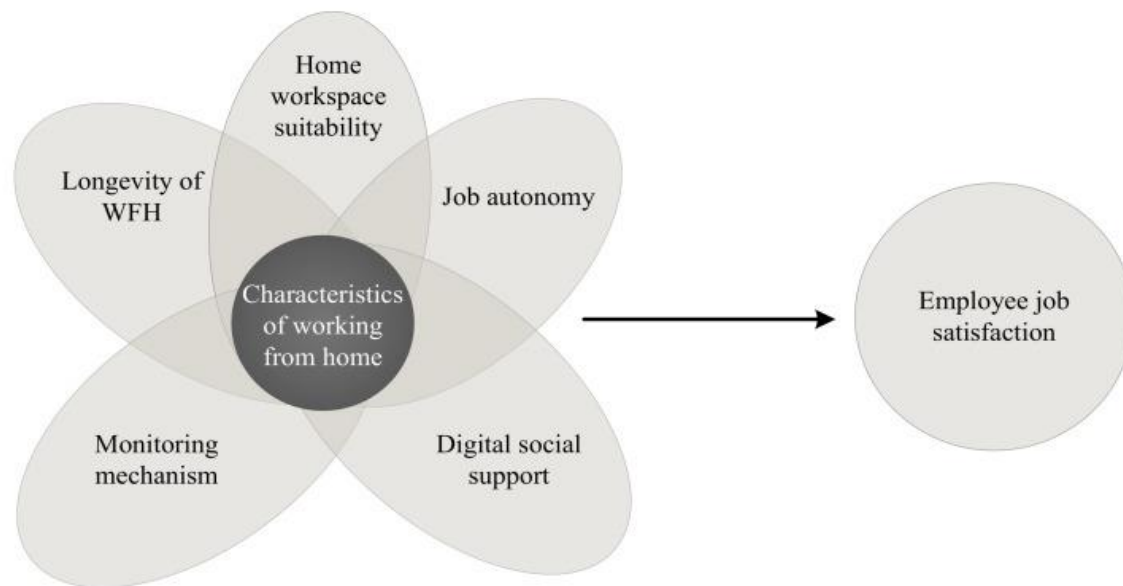
Characteristics of WFH shown below:

Fig 1: Characteristics of WFH

In the organization Human resource (HR) team plays key role while improving organization growth with better employee performance. Chen (2021) studied that impact of COVID on employees due to distance working concept with respect to performance, mental stability of the employee, work-family balance and how HR is important to reinforcement the organization culture. Work from Home have some disadvantages such as data security issues and employee needs to learn many new technologies to cope up with new online platforms and most of the work is being communicated through virtually so, employee stress levels will be increased compared to face to face work culture. Sometimes employee won't be able to balance personal life and work life due to WFH. The result of that is less productivity which HR team should needs to consider (Chen, 2021).

Later Tripati (2020) analysed 1,00,000 tweets for better analyses. The results are positive towards WFH concept. Here the important point to be noted, after analysis is that most of the tweets are based on trust and valid emotions.

Sentiment Analysis: It is an area of study where the motivations, viewpoints, and actions of individuals are examined to increase organizational comprehension and productivity (Liu, 2015). The result of this study leads to the better understanding of the people perspective.

Reason behind choosing Convolution neural network

Convolution neural network (CNN) is one of the best advanced deep learning models which are used for image processing and classification. CNN has the ability to extract a selection of characteristics from the overall sample of research and take into account and then it can analyse how these features are related. The CNN can give better accuracy than the traditional methods such as SVM and Naïve Bayes (Liao et al., 2017).

That's the reason the author wants to perform CNN for sentimental analysis because the layers present in the convolution can extract the large text information and can analyse deeply. CNN is the advanced model for analysing sentiments over many classification tasks like Naïve Bayes, Random Forest, ANN and Decision tree etc. The CNN model can recognize negations (negative words) and n-grams that contain new sentiment information (DataRobot AI Cloud, n.d.).

Cyber Issues

Cyber issues are the threats that a deliberate action meant to steal information, corrupt data, or otherwise to disrupt the digital world. The main reason for cyber issues is digital transformation of the systems in the organization. This pandemic caused big loses for organizations in cyber way also. While this increase in organization demands, it is apparent that many organizations still do not offer a "cyber-safe" distance working environment. Since face-to-face meetings are no longer possible, all meetings are now conducted digitally. Due to this, cyber-attacks are more prevalent now than they were before COVID.

The individuals seems that they are not showing much interest in work from home, because of that they are not following much security or protection measures for their systems caused the hacker to hack easily. As internet connectivity is third party connection the employee needs to check whether it is public access or private with respect to Internet Protocol (IP) address. As per the records of Swissinfo total 350 cyber-attacks happen in Switzerland in April. 47% of phishing scams occurred and this increase of cyber issues is the result of WFH (Tessian, 2020).

There are multiple techniques to steal the data from employees one of the techniques in that is stuffing technique which is used to steal the employee credentials and then the hackers will send those credentials to the cyber criminals. Stuffing technique is very easy because the chance of using same previous username and passwords is common for employees. So, the hacker can use previous combination of credentials to get the current credentials.

Sometimes unwanted people from other companies also attending the virtual teams meeting which can also cause the chance of stealing sensitive and confidential information about the organizations which will cause great damage.

The chances for distraction from work for employees when they are working from home are more because at any point of time the work can interrupt by their family members or other surrounding people. It results human error that can't be identified by systems it's all because of recklessness of employees and IT systems must adjust to these developments. Before COVID the rate cyber cases are 20% and during COVID the rate was risen to 35%. And there are some other new attacks also which can't be predicted because they are some forms of machine learning attacks (Security, 2020).

There are some safe guides that every organization must be followed to overcome the cyber-attacks are explained below (Nabe, 2020).

1. Antivirus projection should be present.
2. Create awareness about cyber security.
3. Virtual private network (VPN) for the environment.
4. Employee should maintain strong secure password (Home network security).
5. Organizations should identify weak spots.
6. Cyber security team always needs to be up to date in skills and with resources.
7. Maintain risk management chart.
8. According to CISOs and CIOs, a zero-trust strategy should need to be implemented

Unprecedented issues from COVID-19 have been met by numerous businesses worldwide, who have proven that they can overcome them by utilizing crisis management strategies that have already been developed (de Lucas, 2020). Organizations categorized the different workspace models based on the locations which will help to find out which employee want to work remote or locally. It will help the productivity growth of the company because employees are working on their interest like choosing their personal option leads to better work life balance and comfort (BCG, 2020).

Research Methodology

An approach of systematically addressing the research challenge is known as research methodology. Simply the author can say studying the research methods is called research methodology. There are different stages in research methodologies. They are Research Philosophies, Research approaches, Research design, Research strategies, Time horizon, Data collection and Data analysis (RESEARCH METHODOLOGY a step-by-step guide for beginners, n.d.).

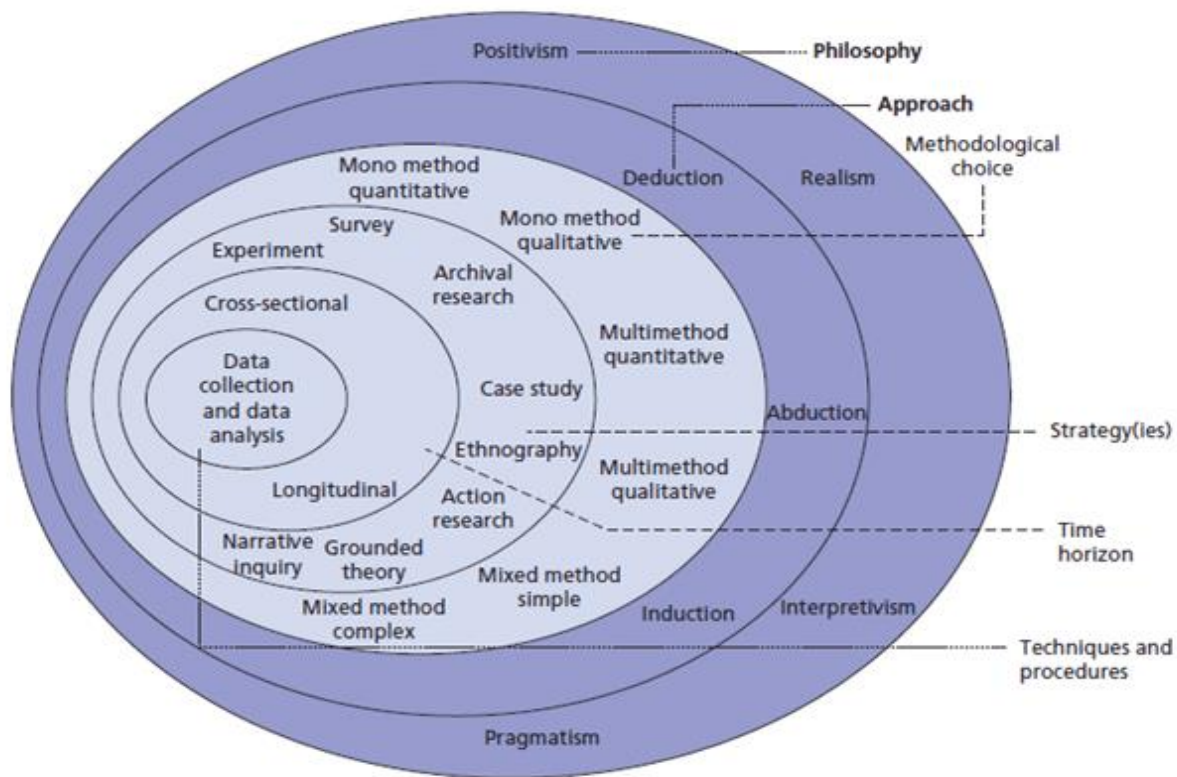The research onion diagram shown below:

Fig 2: Research Onion

Exploratory research is a type of study that considers the perspective of the issue and conducts a complete investigation before drawing a conclusion that was previously uncertain. This study is undertaken in objective way to investigate every employee opinion for getting their opinion on work from home so that organizations may know the impact of work from home for future prediction and comparing the results with the existing predicted models.

Philosophy

There are different types of research philosophies they are **Positivism, critical realism, interpretivism, postmodernism, and pragmatism** (Saunders & Townsend, 2016, p836). The best suited philosophy for this research is realism because the data for this research through surveys which the collection of the data will be done through questionnaires from the employees. This can be analysed through machine learning models and then find the sentiment through the results.

Approach

There are different types of research approaches present in the methodology. For this research the approach suits is deductive. Deductive approach goes from theories to data analysis. First theory will be developed then that will be analysed through the collected data from the experiment. Based on the concepts found during the literature study, questionnaires were created for employees and clients, the researcher did some analysis on the old research study opinions for the survey and added new questions based on the review from the employees. The new opinions added great advantage for the study and then performed advanced ML for finding sentimental analysis (Positive, negative, and neutral emotions). This deductive approach is very effective because it gives new results by dealing with unknowns.

Strategy

It is simply a plan of how you aim to achieve your research goal. There are different types of research strategies present like Experiment, Case study, Survey, Archival research, and Grounded theory etc. Out of this, experiment, survey, and case study are under quantitative approaches. As this study is under quantitative research the author can choose anyone, but research thought that advanced computer research case survey is more useful for this analysis because it works well with exploratory **research nature, deductive research approach and quantitative research design**. So, the suitable research strategy for analysing the impact of COVID on remote working employee work life balance is advanced computer research case survey.

Methods

There are two types of research designs one is quantitative design and second one is qualitative design. Quantitative analysis involves statistical analysis (deals with numbers), which means the researcher determines the relationship between current and upcoming work. The goal of quantitative research is often to evaluate hypotheses deductively by looking for data to either support or disprove them. It works very well with deductive research approach and not well with inductive approach because deductive approach goes from theories to data. And these theories developed in by researchers in inductive nature itself.

In this research the author goes with quantitative research as the research approach is deductive. This design examines relationships between the variables and while doing case study the organizations should consider old results and then investigate further (Soiferman, 2010).

Time Horizon

It is a period which researcher sets the time to finish the research based on objectives and research investigation. There are two types of time horizons present. In that Cross-sectional time horizon is chosen by researcher because as researcher have shorter period to finish the research. In this study participates from different ages studied at the same time. Gathering the employee feedback over several circumstances in a continuous manner in different regions based on COVID is time consuming. Consequently, the author opted for a cross-sectional time horizon rather than a longitudinal one.

Techniques and Procedures

Sampling, Data collection and Tools

In different samples the best suited sample selection is unbiased (probability) simple random sampling because each employee should have the chance of giving feedback or free from expressing their personal opinions through the questionnaires.

Data Collection and Data analysis are under part of the research study, and these can be played very important role for the research. The study is based on employee personal opinions on remote working system on multiple factors. Old research on sentimental analysis for this idea

were conducted by employing little amounts of data and few variables. So, the further research is considered to be with more variables with consideration of age, gender, location preference and designation.

The Python programming language is used for the analysis in the process of machine learning which are very useful for predicting the future output. The future prediction is very important because later if any pandemic happens organizations should have proper idea how to handle the things without going in a direct way. Sentimental analysis is one of the best popular analyses used to find the personal opinions for the customer or employee or people. The primary data collected from surveys, questionnaires and interviews are the main data for the entire analysis. Secondary data also can be gathered through documentation, journals and online portals. There are some pre gathered data sets available in different sites such as Kaggle, GitHub and IEEE which will be helpful for comparing the final results. The author analysed many papers on Google scholar, IEEE, SCOPUS, and Research gate for gathering information about how machine learning models are used in different sectors related to COVID pandemic. The programming part can be done through **Jupiter notebook.**

Questionnaires

The author is trying to gather the data through multiple ways in that one of the major sections is questionnaires. The researcher gathered some common questions which others included and added some extra features (Gender, Age, Department and preference etc,). There are some qualitative questions, and some quantitative questions are present. The questionnaires should be valid for measuring the quality of the data collected from employee's feedback as this response is very important for the future WFH implementation. The data collection from the questionnaire should be in consistent in nature. To measure the reliability the author performed testing (Descriptive statistics) on collected data and will compare with machine learning accuracy for better analysis. Author decides to go for Pilot test for reliability check after data collection then the result can be compared with the machine learning accuracy which got from CNN.

Ethical Principles

The researcher examined the questions multiple times before releasing to the portal whether they may have any sensitive personal data questions or not. The author must assure that the data collected only for analysing for predicting the important features of remote working people due to WFH and won't be used for any other purposes. The collected data will contain employee details such as gender, sex, age, designation, working hours, mental health status, preference, satisfied from WFH or not, suggestions and these data will be kept in safe domain.

Performance Evaluation

The chosen **Load** is performing deep learning model **CNN** for finding the impact of COVID on employees due to remote working.

Since **accuracy** serves as a performance indicator for machine learning, it serves as a **metric** in this study.

The **goal** is to compare the accuracy of current model using CNN with previous models results and analyse with descriptive statistics.

Summary

The researcher will follow above all the steps to find the most important features of post-COVID distance working IT employees through a Neural Network integrated sentiment analysis. The author taken multiple in sites, after analysing required literature reviews with several search engines the author explored importance of sentimental analysis. Researcher has clear idea about aim, objectives and research questions of the topic. As discussed in the research methodology section the researcher gathered the data from multiple data sources, one of the primary sources is conducting advanced computer case survey through questionnaires with deductive approach. The process can be done in short period of time and all the employees contribution taken equally so, cross-sectional time zone considered as horizon.

Plan

Gantt Chart: The workflow plan shown below:

Activity Name	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
Proposal ➢ Aim ➢ Objectives and Research questions	███							
Literature review ➢ Gathering all the resources		███	███					
Data Collection ➢ Journals ➢ Documentation ➢ Kaggle ➢ Questionnaires ➢ Survey ➢ Case study			███	███				
Review datasets ➢ Compare with old sets				███				
Design ➢ Development ➢ Evaluation				███	███			
Testing						███		
Integration							███	███
Dissertation write up ➢ Literature review ➢ Design methods ➢ Results ➢ Conclusion								███

Fig 3: Gantt chart

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