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An Automated personality classification based system for assisting in choosing a career using data mining techniques.

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An Automated Personality Classification Based System for Assisting in Choosing a Career using Data Mining Techniques

By

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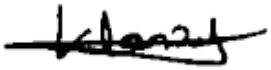
Thesis submitted to the School of Computing and Engineering Sciences in partial fulfilment for the requirements of the degree of master of science in Information Technology of Strathmore University.

July,2021

Declaration/Recommendation

This proposal is my original work and has not been presented for an award of any degree in any university

Signature:  Date: 20th Sept,2021

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Abstract

For successful career development in today's world of work, the empowerment of individuals as autonomous decision-makers is fundamental. This empowerment aims to help individuals in the acquisition of decision-making skills when making transition decisions. A lack of self-awareness is a contributing factor as to why people land in the wrong career. After in-depth research, the researcher found out that deliberating individuals encounter countless challenges in the process of career decision making. After establishing that one's personality can influence how one performs in the work place depending on the career they are in, the researcher sought to create self-awareness to individuals faced with the dilemma of choosing a career that they can thrive in best. To achieve this, the researcher has developed a web application that can automatically classify a person's personality and recommend a career that fits their personality. To achieve its purpose, this study assumed a purposive sampling technique that drew at least 70 respondents based on two classes of participants. One class was composed of high school students and persons considering changing careers. To develop the web application, the researcher used Web Development Life Cycle (WDLC) methodology which combines the components of both Systems Development Life Cycle (SDLC) and Prototyping. WDLC contains two iterative steps of graphical development and functional development. This methodology was found efficient in reducing development time, accords more structure to the research problem and ensures user involvement throughout the development life cycle. From the study findings, it is evident that there is a strong relationship between personality and career choice and that a career recommendation system based on one's personality can make career decision process manageable. This system will be helpful to learning institutions when advising students on career paths to pursue based on their personality type. The prediction of personality is based on MBTI 16 personality types and the data mining algorithm used for classification is K- Nearest Neighbour.

Key words: Personality, Career Choice, Career, Applied Personality Classification, Data mining, KNN

Dedication

This research work is dedicated to my family for their selfless support while undertaking my Master's program.

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Abbreviations and Acronyms

APC	-	Automated Personality Classification
CASVE	-	Communication, Analysis, Synthesis, Valuing and Execution
CIP	-	Cognitive Information Processing
KADS	-	Knowledge Acquisition and Documentation structuring
KCS	-	Kuder Career Search
KNN	-	K-Nearest Neighbour
MBTI	-	Myers-Briggs Type Indicator
SVM	-	Support Vector Machine
UML	-	Unified Modelling Language
WDLC	-	Web Development Life Cycle
WWW	-	World Wide Web

Definition of Terms

Application	A software program that is developed and hosted on an online server for easy access by a user (French, 2011).
Automated-Personality--Classification	An application that evaluates a person's personality in relation to given features using data mining techniques (Singh & Swasti, 2020).
Career choice	the process of selecting a given type of vocation (Athanasou & Perera, 2019).
Career	A given vocation that calls for either formal or informal training for One to perform (Athanasou & Perera, 2019).
Personality Traits	Refers to a person's aptitudes, abilities, interests, ambitions, resources and limitations (Digman, 1991).
Personality-career fit	refers to degree to which a person's interests and personality match the demand and opportunities brought about by working in a given career environment. (Holland, 1997).

Chapter 1: Introduction

1.1 Background of the Study

Neuro Linguistic Programming (NLP) refers to techniques that can ascertain a person's thought process, how a person communicates and behave (Mohammad H. A & Hassan K., 2020). Through NLP we are able to detect the patterns in people's behaviour. Meta programs are a vital factor in NLP. Mohammad H. A & Hassan K (2020) explains that a person's meta-programs are the cognitive strategies that run all the time and help the person to sort any form of information that he comes across. Further, Davis (2020) in his website indicates that Meta programs are habitual ways of inputting, sorting and filtering the information found in the world around us. In other words, they are our thinking styles or typical strategies and patterns. According to Ellerton (2018), meta programs usually do have a big influence on behaviours and also on how people communicate with others. Consequently, this leads to significant differences in behaviour from one person to another, what is referred to as one's personality.

Personality is defined as the characteristics that make a person unique in terms of their way of thoughts, emotions, behaviours, habits and interests while influencing how one make decisions in life (Brown & Lent, 2005). One's personality determines every element of his or her career. Fundamental career decisions such as occupational choice, early-career socialization, job performance, career satisfaction and career changes are affected by one's personality. Our personality influences our human relation skills which in turn allow us to deal with situations and other people better (Yash Mehta. et. al., 2019).

According to Daniel (2004), human relations and emotional intelligence, which are a significant part of one's personality, determine excellent performance at work. Within the workplace, one is likely to come across difficult bosses and colleagues who don't enjoy working with or even turbulent personal relationships. The ability to handle the challenging situations will highly depend on one's personality (Daniel, 2004). Even though choosing a career can prove to be a daunting task, having self-awareness can help one choose the occupation in which they best fit with regard to their strengths and weaknesses. After one gets into the right job where they can blend well with the environment, only then are they able to improve their innate strengths.

John Holland's theory is a prime example of person-occupation fit research. The theory examines the congruence between people's career interests and occupational environments. People look for careers that match their interests; such a fit result in vocational stability, satisfaction, and high achievement. When a person's interest poorly fits within a given career, they in-turn become unfulfilled, perform poorly and even stagnate in one cadre since they are unable to manoeuvre their way up the corporate ladder. According to Holland, professional interests are a fundamental component of one's personality (Brown, Lent, & Robert, 2005). One can only choose the right career if they can understand their personality and the work environment where they best fit.

An automated personality Classification system can assist job seekers, those who want to change careers or those who are looking for a field to train in make an informed decision (Mehta, Majumder, Gelbukh, & Cambria, 2019). Automated Personality Classification (APC) is a system that analyses user personality based on certain features using Data Mining techniques. Data mining is the process of analysing hidden patterns of data according to different perspectives for categorization into useful information, which is collected and assembled in common areas for efficient analysis for purposes of decision making (Amirhosseini & Kazemian, 2020).

The techniques that can be used for data mining are Regression, classification, outer detection clustering, Association Rules, prediction, and sequential patterns (Techopedia, 2017). For this study, by grouping the different traits of persons from their behavioural data, the researcher was able to classify persons into different career groups based on their resultant personality. This was achieved by the use of k-Nearest Neighbours algorithm along with advanced data mining to mine user characteristics data and learn from the patterns. This learning was then used to predict user personality based on past classifications and associating the personality type with the right career fit.

1.2 Problem Statement

The world of work is very complex. It is faced with recurrent changes that have made career paths unpredictable, multi-decisional, and unstable (Mitchell, Levin, & Krumboltz, 1999). In the world of work today, there is a need to empower individuals to become autonomous decision-makers. For successful career development, this empowerment should aim to help individuals to acquire decision-making skills. Lack of empowerment has led many people to

realise that the career they are in is not the best fit for them while already in the marketplace. This can be attributed to the fact that our choice of career is majorly based on the remuneration, location, training time before earning, prestige of a given profession and most a time based on training skills received (Mitchell, Levin, & Krumboltz, 1999).

Being in the wrong career can lead one to depression, poor productivity, career stagnation, or even severed relationships. According to Sheri (2015), a lack of self-awareness is one of the reasons as to why one is likely to choose the wrong career. This is to mean that one is only able to choose the correct career path only when they have a clear understanding of the profession where their personality best fits in. Even though we have a variety of occupations and jobs for individuals to choose from, the choice of an alternative that meets one's interests, abilities, needs and skills becomes complicated and many land in the wrong profession (Sheri,2015).

The ability to make a career choice while faced with many alternatives is further complicated by the unpredictable work changes (Schwartz, 2004). The many alternatives present an overload of choice that require lots of effort and expertise that the subject may not have. This means that subjects are hardly likely to benefit from the large pool of alternatives (Schwartz,2004). To make good use of the alternatives, deliberating individuals have the option to carry out an in-depth information gathering. With substantial quality information, they are then likely to do a detailed exploration of any promising alternatives after weighing their pros and cons. (Gati and Asher, 2001; Germeijs et al., 2012).

1.3 Research Objectives

i. To analyse the challenges that individuals' face in career decision-making process
ii. To analyse the relationship between personality and career
iii. To review the techniques that have been used in career assessment
iv. To develop an automated personality classification system that can match given personality traits with a given vocation
v. To test the developed system

1.4 Research Questions

i. How do career decision-making challenges affect individuals'?
ii. How is personality related to career choice?

iii. What are the techniques that have been used in career assessment?

iv. How can an automated personality classification system that can match individual's personality traits with a given career be developed?

v. How can the developed system be tested?

1.5 Justification

With the help of the developed personality-based system, high school students can have a rough idea of the training programs they should choose. Those deliberating on change of careers they are able to choose a career where they can thrive and succeed. Job seekers are able to choose careers where their personality can naturally blend. This way they are able to become more productive and can then grow in their career.

Career trainers through the help of the system are able to best match their clients' personality to the profession where they can best grow. When implemented in high school and training institutions, career guidance personnel are able to guide their students on the best training for them.

1.6 Scope and Limitations

This research focused on personality as the only consideration when choosing a career. This means that the study assumed with or without the relevant training, when one is correctly positioned in the profession where their passion and interests are put into test, they can easily flourish in that profession. The study will be conducted in Machakos County with students drawn from Mavoko Secondary School. Persons intending to change careers will also be part of the participants. The developed application will be web based. Therefore, it will be accessible to users with internet connection.

Chapter 2: Literature Review

2.1 Introduction

During adulthood, the nature of work is dynamic. The need for career transitions can come up either because one desires new challenges, in preparation for retirement or employment after retirement. However, changes in global economies and nature of work make the event stressful (Jiang, Hu, & Wang, 2018). To survive in the workplace, theories on person-environment congruence have been developed. These theories assume that people have vocational personalities that determine how salient for work one is, how effective they match to the work environment and the job demands (Holland, 1997; Dawis, 2005). Faced with many career alternatives to choose from, there is a need to choose a field whereby one can thrive and succeed. In this chapter, the researcher will explore the applicability of a personality based system as a feasible solution to choosing a career.

2.2 Empirical Literature

2.2.1 Career Decision Defined

According to Athanasou & Perera (2019), choosing a career is among the most important decision that one has to make in their lifetime. Such a choice will influence a person's success, satisfaction and happiness in life depending on how accurate the decision is made. These decisions encompass picking a course major to pursue, an internship, specialized training, or even what occupations to send applications to and what career proposals to pursue, and resignation decisions or undertake new assignments within the organization or change to another organization (Di Fabio & Kenny, 2015).

The choice that one will pursue has substantial long-term repercussions in regards to one's lifestyle, emotional wellbeing, social and economic standing, productivity to humanity and sense of personal contribution. Because of the mentioned reasons, one has to make choices as pertains their career throughout their lives (Di Fabio, Maree, & Kenny, 2018). Conversely, folks struggle to make such decisions. This is because of the unprecedented world transformation in the world of work which has greatly amplified the difficulty involved in looking for favourable career substitutes and choice (Gati & Levin, 2014).

2.2.2 Career Decision Making Process

When faced with many career path alternatives, it is important to design procedures for making career decisions. Such procedures should demonstrate modalities that enable one to make satisfying career choices through the adoption of a decision-making model. However, the world of work is composed of many dynamics that make the career decision-making process complex and challenging (Athanasou & Perera, 2019). Gati and Levin (2012) demonstrated that the features of decision theories are applicable in career decision- making process. When faced with the dilemma of choosing a career one has to: choose what they would want to do, have set objectives to accomplish, have a set of alternative trajectories worth pursuing, have a number of crucial factors worth consideration in the evaluation of the alternatives. All these aspects further complicate the decision-making process.

2.2.3 Characteristics and their Corresponding Challenges in Career Decision-Making Process

Recounting the special characteristics of choosing a career is an interesting factor that can greatly aid in understanding the ways in which the challenges involved in making these choices can be overcome. Athanasou & Perera (2019) explains that scenarios requiring decision making vary depending on the purpose of the decision, the amount and accuracy of information required to aid in decision making, the complexity and type of processing that the information needs. For that reason, situations that require decisions call for varying processes so as to reach an optimal decision. Across one's life, the level of cognitive maturation will affect how one makes decisions. A secondary school candidate will find challenges in choosing a career as compared to someone who is about to change careers (Lipshits-Braziler, 2018). The career decision making characteristics and their corresponding challenges are as follows; -

2.2.3.1 The Importance of the Decision

When a person makes an important decision like accepting a job that requires one to relocate, the repercussion of such an action vary in intensity. According to (Athanasou & Perera, 2019), a career will influence several life aspects like the ability to realize one's dream lifestyle, association with significant other, environment and societal networks as well as one's sense of well-being and meaning. Therefore, it is very important that one makes the appropriate career decision so as to minimize the financial and psychological risks that maybe involved. Faced with

the need to lessen or avoid these risks, the process of career decision-making becomes stressful due to increased anxiety levels (Lipshits-Braziler, 2018).

2.2.3.2 Information About Career Alternatives

In today's world, there exists career alternatives that one has to choose from. Lent (2018) reminiscences the fact that a profession is a lifetime practise having many transitions and plenty of steps that don't necessarily aim at achieving a specific goal but aimed at coping with unprecedented opportunities and transformations. In the past, traditional career path was linear and progressive, however, the post-modern career path has numerous links with each offering multiple directions for consideration (Hirschi, 2018).

Even though faced with the big pool of jobs and occupations to choose from, the complexity of the decision is amplified by the copious amounts of alternatives and the changeableness of the workplace. According to Schwartz (2004), individuals face an overload of choices that calls for great effort to make any meaningful decision instead of benefiting from the abundance of career alternatives. This means that there is a need to come up with a mode of pre-screening that can compile a shortlist of correlated alternatives worth more assessment by deliberating individuals (Shimoni, Gutentag, & Gati, 2018)

2.2.3.2 Information on an Individual's Career Preferences

The purpose of making a decision about a career is to uncover the best alternative that fits a person's characteristics besides their life goals. To ensure the best fit, after collecting occupational information, it's equally prudent for one to clarify their capabilities and preferences. However, many deliberating individuals face a daunting challenge (Gati, Krausz & Osipow, 1996). Although occupational information can be accessed by a mere exploration of the environment, career-related preferences can only be clarified after an intensive introspection. Levin and Gati (2015) expressed that biases are known to further impact a how a person views the world of work, his abilities and preferences. Individuals deliberating on choosing a career need to be able to define their preferences depending on their vocational interests, personality types, work values, needs, occupational attributes and work-aspect or career related preferences (Athanasou & Perera, 2019). To elicit one's preferences, profiling preferred activities based on past experience and being aware of one's skills, values, interests and capabilities are techniques that can be used. (Krieshok, Black, & McKay, 2009). Using the individual core preferences which emanate from ones personality type

for the decision making can greatly aid them in making the most appropriate career choice (Gati & Gutentag, 2015).

2.2.3.3 Adaptability of Different Approaches

After obtaining the relevant occupational information to aid in career choice, one needs to process the information a task that many deliberating individuals find complex, difficult and multifaceted at the same time (Amir, Gati, & Kleiman, 2008). However, each individual has a unique way in which they make career decisions as described by (Gati & Levin, 2012). According to Gati and Levin (2012) to make career decisions, individuals will either use analytical information processing versus holistic, procrastinate, use intuition, dependent on others. The process of comparing alternatives can become very complex due to difficulty of collecting the information relevant to a given occupation. Since numerous attributes can be used to describe occupational alternatives and individual preferences, there is a need to come up with a model that can compare personal attributes and career alternatives so as to ease the process of processing the vast occupational information.

2.2.4 Determinants in Choosing a Career

The initial consideration to choose a given career needs one to know the potential opportunities available. Such a choice is strongly influenced by intrinsic individual factors like self-awareness, gender, personality, personal goals and values, age and generational issues. The intrinsic factors are further modified by work or home environment factors like family circumstances, quality of life and work life balance, flexibility, work environment, positive and negative experiences and serendipity, morale and esteem of the profession (Shadbolt & Bunker, 2009). All these factors in isolation or a combination have a great influence in the career decision-making process.

2.2.5 Effects of Making Wrong Career Choice

Selecting the right career requires proper guidance or planning since the probability of making the wrong choices is even higher. Ibrahim (2011) explains that since the idea of choosing a career is uncoordinated the chances of making an inappropriate decision are greatly increased. As indicated in table 2.1, the probability of choosing the wrong career increases with the number of alternatives to choose from

Table 2.1 The probability of choosing the wrong or right career. (Reprinted from Ibrahim, 2011)

Number of careers to choose from	**Probability of making the right choice**	**Probability of making the wrong choice**
1 career	0.5	0.50
2 careers	0.25	0.75
3 careers	0.125	0.875
4 careers	0.063	0.937
5 careers	0.031	0.968
6 careers	0.16	0.984
7 careers	0.08	0.992
8 careers	0.004	0.996
9 careers	0.002	0.998
10 careers	0.001	0.999

In the twenty first century, the evolution witnessed in the job market owing to growth in technological advancement has seen the emergence of many occupational disciplines that have rendered some occupations obsolete while other new fields have emerged. This is to mean that if one doesn't correctly understand where they naturally fit, they are likely to land in the wrong career. As discussed by (Ibrahim, 2011) the consequences of choosing the wrong career include lack of job satisfaction, being unproductive, poorly executed projects and build-up of vices.

So as to ensure that we get individuals who are given to service delivery in the workplace, it is of essence that we have those deliberating on what career path to choose well guided. Such guidance can be accorded only when an individual's preferences are determined before they enter into the industry One of the ways in which such guidance can be offered is through determining one's personality and values and then proposing to them the career group where they can best fit in. (Ibrahim, 2011).

2.3 Theoretical Literature

2.3.1 Personality and career choice

Personality refers to the qualities that render people unique and is a crucial determining factor of general human behaviour and careers precisely. Anthropological personality has both a direct and indirect influence on what we do and who we are by impacting on the choices we make. Thus, personality if taken into consideration can play a great role in assisting people decide on occupations that may or may not be a good fit for them (Tokar, Fischer, & Subich, 1998).

Many aspects of personality have been associated with career development. This is because almost every part of an individual's career is partly determined by his or her personality. For instance, fundamental career decisions like choice of occupation, job satisfaction and performance, early occupational socialization, job tenure and turnover are affected by personality (Boudreau, Boswell, & Judge, 2016). Tokar, Fischer, & Subich (1998) in their selective review of literature on personality and vocational behaviour, were able to note that personality is a key element in career choice-related process i.e. interests, attitudes and values, aspirations, maturity and decision making.

Personality is as well linked to general career processes i.e. job searches, multiple roles, career progression and changes, mentoring, congruence and career commitment, occupational satisfaction and well-being i.e. occupational stress, burnout, job satisfaction, strain and organizational outcomes i.e. job performance and any desirable of undesirable outcomes (Tokar, Fischer, & Subich, 1998). This therefore means that personality meaningfully relates to the nature of occupations people choose and such a choice affects how they perform in that specific career.

2.3.2 The Concept of Career Fit: Theory of Work Adjustment

To increase the understanding of many work-related issues like career development, there is a need to examine the fit between an individual and environment so as to gain insights into human behaviour. The congruence between a person and the environment they operate brings

about outcomes like job satisfaction, performance, turnover and job tenure. The theory of work adjustment considers the interaction and response between people and environment. This theory proposes that work adjustment can be described by the two propositions that satisfaction drives behaviour and satisfaction is a function of correspondence between people and environment (Dawis & Lofquist, 1984)

When a person's abilities and job requirements fit, there will be satisfaction since there is a match between people's desires and needs and the rewards obtainable from a particular occupation. It is believed that as people take a longer time on a particular job, the satisfaction and satisfactoriness will consequently increase. However, as time goes by, both factors are influenced by environmental and individual factors. As the environmental factors in the work environment change over time, the theory suggests four personality styles (i.e. celerity, Pace, Rhythm, Endurance) that help individuals to cope with the changes (Dawis, 2005).

Dawis (2005) further explains that people who are uncomfortable with a lack of correspondence are high in celerity. They are more likely to change jobs or commence changes within themselves or the environment so as to cope with the discomfort. In situations where correspondence fluctuates, some people may decide to go to great lengths so as to meet the job demands while those of low pace may decide to do nothing. Rhythm as a personality style denotes the pattern of effort people used to attain correspondence. Some people will work towards achieving a steady correspondence while others will strive to gain correspondence when it best suits them. People with endurance form of personality will be persistent in interacting and responding to the environment (Dawis R. V., 2005). In view of this theory, it is imperative that in order to survive within a given environment, an individual's personality plays an integral part in the process.

2.3.2 Personality Types: Big Five Factors of Personality

The big five factor model of personality is the most widely accepted personality attributes framework. This framework was created in the 1970s by two research groups led by researchers from the National Institutes of Health, the University of Michigan and the University of Oregon (Parihar, Kulshrestha, & Scholar, 2018). The five types of personality according to this model are Emotional Stability i.e. tendency to become emotionally upset, Extraversion i.e. how outgoing and social a person is, Openness i.e. the level of one's open-mindedness, Agreeableness i.e. a person's

positive or negative orientation towards others and lastly conscientiousness i.e. one's ability to exercise self-control and discipline while pursuing their life goals (De Raad & Perugini, 2002)

The big five framework has been utilized in occupational domains in relating outcomes and organizational behaviour (De Raad & Perugini, 2002). The big five factor framework has associated personality to vocational interests and career decisions. Depending on one's personality, a person will be attracted to a particular career hence the kind of jobs they search for or choose. (Big Five Personality Factors, 2020). According to Judge et al., (1999), one's professional preparation, success in education and training for the job will be influenced by their personality. Personality will in a big way influence a person's performance in a given task hence their overall job (Roberts & Hogan, 2001). Roberts & Hogan (2001) further argues that personality will influence an individual's work attitude, organisational behaviors, understanding and job satisfaction and career success in terms of salary, occupational status or satisfaction with one's choice of occupation and position (Judge et al., 1999).

The big five dimensions have been found to be generalizable and hence the same big five personality characteristics have been assessed in a multitude of different personality measures like Myers-Briggs Type Indicator (Digman, 1991). Myers-Briggs Type Indicator (MBTI) is a measure of adult personality that has been implemented in settings like career development and placement, counselling, personnel selection and consulting. MBTI has been used to help understand the basic elements (traits) that make up human personality based on four indispensable psychological functions through which we view the world. These functions are intuition, sensation, thinking and feeling. This measure of personality uses factor analysis to ascertain the elementary traits among a hefty set of behavioural observations (Cattell & Schuerger, 2003). Through MBTI, people are able to self-evaluate themselves and identify their preferences based on their interests, values, needs and motivation. By combining one's preference, it is then possible to arrive at a personality type. It is then that from the personality type that one is able to decode on the career path that they can comfortably thrive.

Table 2.2 Careers Based on MBTI Personality (Reprinted from Yaser, 2018)

ISTJ	**ISFJ**	**INFJ**	**INTJ**
Management	Education	Religion	Scientific or Technical Field
Administration	Health Care	Counselling	Computers
Law enforcement	Religious Settings	Teaching	Law
Accounting		Arts	
ISTP	**ISFP**	**INFP**	**INTP**
Skilled Trades	Healthcare	Counselling	Scientific or
Technical Fields	Business	Writing	Technical Fields
Agriculture	Law Enforcement	Arts	
Law Enforcement			
Military			
ESTP	**ESFP**	**ENFP**	**ENTP**
Marketing	Health care	Counselling	Science
Skilled Trades	Teaching	Teaching	Management
Business	Coaching	Religion	Technology
Law Enforcement	Childcare Worker	Arts	Arts
Applied Technology	Skilled worker		
ESTJ	**ESFJ**	**ENFJ**	**ENTJ**
Management	Education	Religion	Management
Administration	Health Care	Arts	Leadership
Law Enforcement	Religion	Teaching	

2.4 Models Used in Career Assessment

Career assessment refers to the assessments and tests that are administered to an individual so as to measure his/her preference to the various jobs and career types based on his or her own character traits, skills and personality (Career Assessment, 2020)**.** There are various assessments that have been applied as per the following discussions.

2.4.1 The Kuder Career Search with Person Match (KCS)

The Kuder interest assessment contains three sections. The first section shows the assessment taker's interests grouped into six Kuder Clusters (Arts/Communication, Business Operations, Outdoor/Mechanical, Sales/ Management, Science/Technology, and Social/Personal Services). Each profile cluster results are showed from highest similarity to lowest in bar graph format. The second section of the KCS helps persons in exploring careers based on educational levels. The last section, Person Match, matches persons to people in existing jobs. An alteration of Spearman's rank order correlation**, (**a nonparametric measure of the strength and direction of association that exists between two variables measured on at least an ordinal scale),is used to compare the assessment taker's KCS responses with the KCS profiles of individuals found in the reference pool for Person Match so as to opt for the most relatable matches (Savickas, 1993).

2.4.2 Cognitive Information Processing (CIP) Model

CIP model enable persons to develop appropriate skills for solving career problems and making appropriate decisions. The model assumes that they can apply the experience to future problems concerning their careers. The CIP paradigm provides a mode of describing the essential thought processes and memory structures intricate to making career decisions and solving career problems. Through the use of interest and values inventories, ability and skills assessment one is able to acquire self-knowledge. Individuals are further advised to write autobiographies that help them to describe and organize life experiences related to career problem. To gain occupational knowledge, an individual can consult vocational biographies, occupational briefs, special topic books, reference books, interactive media, videos and internet websites. They can even interview people in the industry they are interested in or even just undertake an internship within the industry so as to get a real test of the job. CIP model assumes that for persons to acquire career problem solving and decision-making skills, they are trained on the Communication, Analysis, Synthesis, Valuing and Execution(CASVE) cycle shown in figure 2.1 (Sampson et al.,1992). After an individual examines himself and the career alternatives, only then he/ she is able to make an informed decision as suggested by CIP model

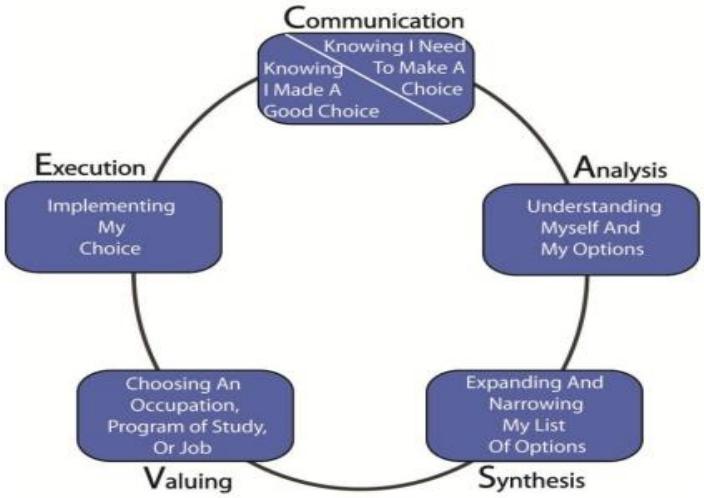

Figure 2.1: The CASVE Cycle of information processing skills (Adapted from (West White, 2015))

Table 2.3 Translation of Terms from CASVE Cycle Adapted from (West-White & Clarissa, 2015)

CASVE Cycle	**Decision Cycle**	**Meaning**
Communication	Engaging	Knowing I need to make a choice
Analysis	Understanding	Understanding myself and my options
Synthesis	Identifying	Expanding and narrowing my list of options
Valuing	Deciding	Choosing an occupation, program of study, or job
Execution	Acting	Implementing my choice
Communication	Reflecting	Knowing I made a good choice

2.4.3 Pre-screening, in-Depth Exploration, and Choice (PIC) Model

The PIC model was proposed by Asher and Gati in 2001 and is based on decision theory. The model consists of three stages. The first stage involves examining the possible set of career alternatives so as to come up with a small but manageable set of favourable alternatives. Next, the favourable alternatives are further explored so as to remain with just a few but suitable alternatives and lastly, the most compatible alternative based on an in-depth comparison between the suitable alternatives is chosen (Gati & Tal, 2008).The steps are shown in Figure2.2

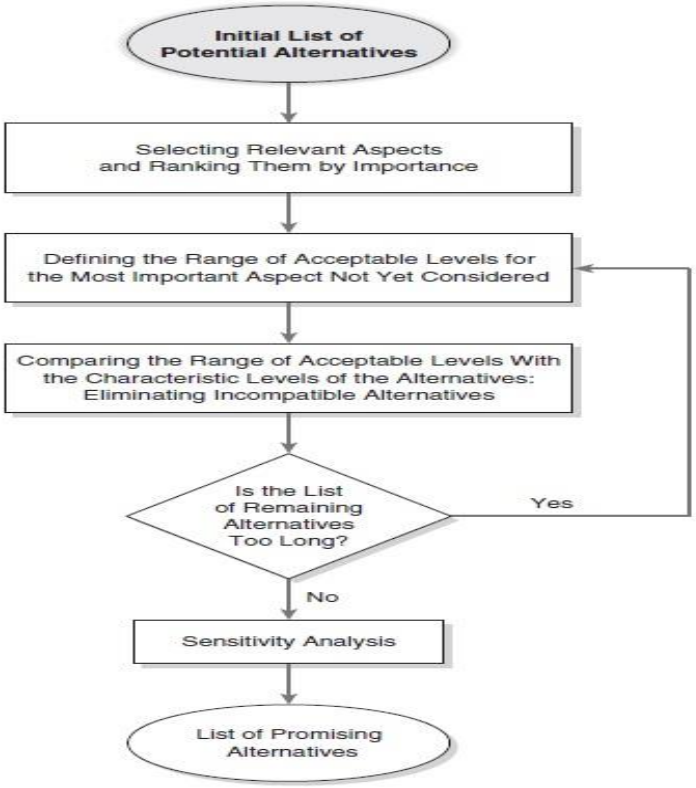

Figure 2.2: Steps in PIC model Adapted from (Gati, 1986).

2.4.5 Gaps in Reviewed Models

As implied by both John Hollands theory and work adjustment theory, to attain career success, which is the ultimate goal of engaging in meaningful career, personality has a key role to play. Since personality will determine how a person interacts and responds to the environment they are in, it should therefore be an integral consideration in connection to career fit. From the review, it is clear that these models of career assessment concentrate on external factors of deciding whether a given career is fit or not fit for a person. To be able to thrive and endure in a given occupation, personality which is intrinsic to a deliberating person is the best starting point to choosing the best career match for oneself. Consequently, it is important to come up with a career assessment model that relates one's personality to the career where they can naturally thrive successfully.

2.5 Application of Automated Personality Classification as a Solution

To mend the gaps established in the review of models used in career assessment, the researcher sought to establish the validity of automating personality classification as a basis for recommending a career.

2.5.1 Automated personality classification

The identification of the personality of a person is an old technique that consumed a lot of time to predict the nature of a person since it was done manually. There are many scenarios where personality can be applied. However, doing it manually can prove to be cumbersome and time wasting. To help simplify the process of personality identification, automation is inevitable. To automate the process various machine learning algorithms like data mining algorithms can be used (Ma & Liu, 2017). Data mining is primarily applicable to companies that majorly focus on the consumer like communication, financial, retail, and marketing organizations. The techniques used to scrutinize the data include questionnaires, interviews, surveys, shopping website data, classroom activities, social network data concerning user experiences and problems they face while accessing their services. However, these traditional techniques are time intensive and have a very limited scale.

The manual analysis is not applicable for voluminous data and again the interpretation done by humans is prone to biases and prejudices which affects the accuracy of their conclusions. Also, there is loss of information in situations where disclosure during information gathering occurs (Ma & Liu, 2017). Data mining is the method of finding pattern in vast data sets that involve techniques at the interaction of statistics, database systems and machine learning. The overall goal of data mining is to come up with information from these datasets and transfer the produced information to aid in decision making. The automation of personality involves comparing a user's personality alongside standard personality tests previously taken. Majorly, personality prediction depends on an individual's nature. To predict on an individual's personality, some assessment is taken by presenting a set of questions and depending on the answers the user gives to the questions asked, their personality is known. The classification algorithm used in this case is the N-closest neighbour.

2.5.2 Data mining in Automated personality classification

Data mining is a method that helps to identify patterns and structures that are hidden in small or large datasets with the aim of solving various problems by analysing data or applying machine learning algorithms on the dataset((Bharadwaj, S. Sridhar, & Srinath, 2018). To discover insights from data, data mining uses Artificial Intelligence, machine learning, statistics and databases hence becoming a multidisciplinary field. Precisely, data mining refers to knowledge discovery, pattern or data analysis, information harvesting, and many others. knowledge gained by data mining methodologies can be applied in diverse fields, such as market analysis, biogenetics , etc (Bharadwaj, S. Sridhar, & Srinath, 2018). Data mining tools and techniques help several organizations to predict future trends by analysing the past or current data.

In data mining, different association rules are created by analysing the data and extracting useful information out of it. To get the valuable insights from a data, many data mining techniques are applied. After acquiring data from which insights are to be sought, the dataset has to go through pre-processing whereby all lower-case, symbols, names, spaces, etc. are removed and the remaining words are then converted into English (Jadhav & Channe, 2018).

Some of the data mining techniques that are applied on personality classification include K-Nearest Neighbour, K means, Support Vector Machine, etc. In this study, the automated personality consists of comparing user's personality against standard personality tests taken. Mainly personality prediction depends on person's nature. Several tests will be taken by asking set of questions and depending on the answers chosen by the user, personality will be predicted. Classification algorithm used is K-Nearest neighbour. It is very important to process large volume of data and this can be done by Classification algorithm (Jadhav1 & Channe, 2017).

K-Nearest Neighbour is a simple machine learning algorithm that is easy to understand and implement. This methodology assumes that patterns with similar features will always lie in sectors close by (Cover & Har, 2011).KNN is a supervised learning algorithm which is a lazy learner that requires less computation time during the training process but more time while classification process is underway.

2.5.3 Review of Personality Prediction Models

Yata et al (2018) in his paper have implemented a multi-label classifier on text data by collecting views and opinions of users as posted on social media platforms. They have used classification algorithms like SVM, Naïve Bayes, K- nearest neighbours, and multi-label classifiers to predict personality. They then compared the accuracy of the models and from the findings they implemented the most accurate model. From their results they found out KNN gives the optimal results. Even though they have given the efficiency of the models, they did not give a practical application of personality classification.

Tandera, Hendro, Suhartono, Wongso, & Prasetio (2017) developed a personality prediction system from Facebook. Here, they demonstrated how the latest Big Five Model Personality can be applied for Personality detection. They then developed a system that can predict an individual's personality based on their Facebook user data. However, they did not demonstrate how their system can be applied in making the society a better place.

Kumar et al (2017) in their paper gave an overview of data mining algorithm that have been applied in the prediction of student profile and personality so as to predict a favourable career or occupation for the students. To arrive at the prediction, they developed an online survey system that could assist students in making career choices while understanding their personality. The students profile prediction was based on IQ test and logical score. Personality prediction was based on a psychometric test that was applied. However, this approach is beneficial for the academic progress of students and the efficiency of the algorithms used was not specified.

2.6 Conceptual Framework

The review of related literature has revealed that personality can be measured through the use of psychometric tests which can be administered to a user. It was also discovered that personality controls human behaviour and there is an intimate relationship between personality, human behaviour and career success. Therefore, based on the mentioned discoveries, the study proposes to develop a web application that can subject users to a psychometric test based on MBTI personality test. User's answers to the questions will be classified by use of KNN closest Neighbour algorithm which will be able to classify user personality. From the resultant personality the recommendation engine will be able to suggest the most suitable career for the user. The

researcher will assume the conceptual framework in Figure 2.3 to aid in coming up with a working application.

Table 2.4: Table of Operationalised Variables

	The variable	**Operationalised Variable**
Independent Variable	Personality traits	As revealed after taking MBTI test
Dependent Variables	Career Type	As indicated in Table 2.2

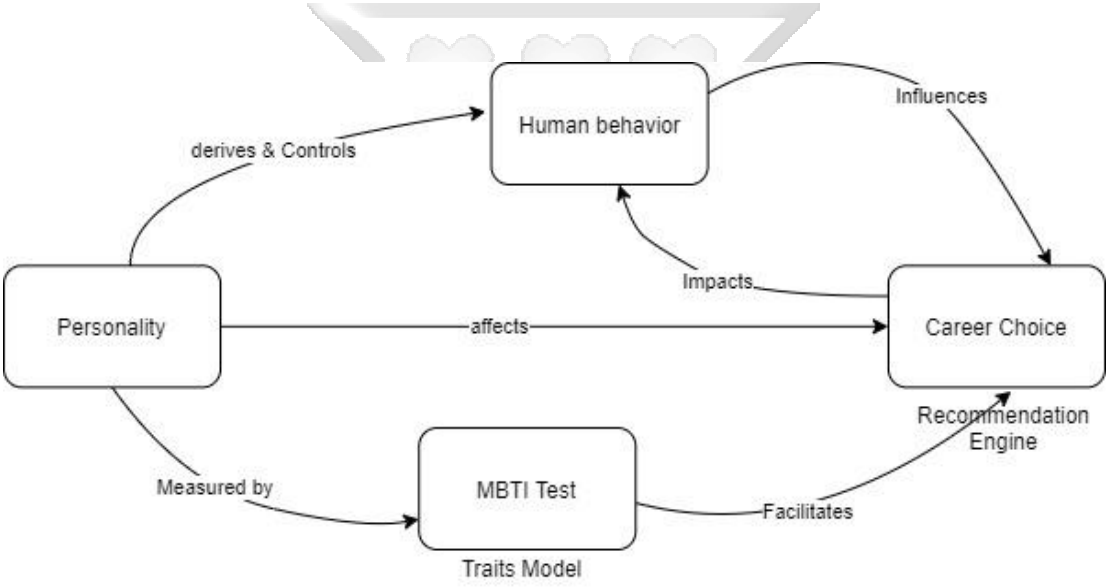

Figure 2.3: Conceptual Model

Chapter 3: Research Methodology

3.1 Introduction

Research is an art that utilises scientific techniques to investigate a problem with the aim of coming up with a solution (Kothari, 2014). In the event one wants to find probable solutions to a given problem, the first step is to come up with relevant objectives from which he can get a better understanding of the problem. This understanding requires one to collect sufficient information and come up with a systematic plan of assessing the information in relation to the objectives. The results of this assessment will allow a better understanding of the problem (Bajpan, 2011). The right research methodology enables a researcher to apply the relevant research methods so as to meet the study objectives (Kothari, 2014). The research methodology adopted will determine the quality and extend to which research work is done. This chapter discusses the research methodology that was adopted in the development and testing of the proposed web application. The process of System analysis, design, implementation, testing and evaluation methods was also discussed with the aim of fulfilling the study objectives.

3.2 Research Design

Research design is the conceptual structure within which a study is carried out. It contains the blueprint for collecting, measuring and analysing the data (Kothari, 2014). (Bervins, 1999) advices researchers to consider various concepts while choosing a given research design. The concepts are manipulation, random assignment, bias, causality, control and random selection (Bervins, 1999). In view of the concepts, this study adopted ex-post facto research design. The ex-post facto research design is a technique that implements some aspects of a true experiment in the comparisons of subjects belonging to different groups though having same backgrounds and dissimilar prevalent conditions that are naturally occurring in them with the aim of exploring causal relationships (Badia & Lammers, 2005). It can be applied in examining whether one or more pre-existing conditions could cause subsequent differences in a given group of subjects (Santos & Santos, 2015). This form of research design does not allow the researcher to manipulate the independent variable (Badia & Lammers, 2005). However, this design was found to be useful in bringing about the relationship between personality and career choice, is economical and less time consuming (Bervins, 1999).

3.3 Methodology

According to (Kothari, 2014) a research methodology refers to the systematic , hypothetical scrutiny of the procedures used in a field of study. It consists of procedures for describing, expounding and predicting an occurrence that aims to solve a problem. A researcher has to choose the best methodology that enables him to attain the objectives of his research work (Sachveda, 2010). For this study the researcher adopted a methodology referred to as Web Development Life Cycle (WDLC) Methodology.

WDLC is a hybrid of two software development methodologies namely waterfall approach of Systems Development Life Cycle (SDLC) and Prototyping. By combining the components of each methodology, through WDLC, the development time is decreased, more structure is accorded to the problem being solved and the approach ensures that users are involved during the development life cycle (French, 2011) . To ensure that the developed system is coherent with a complex design that satisfies users and is legible to warrant the users to want to use it, WDLC contains two iterative steps of graphical development and functional development (French, 2011).

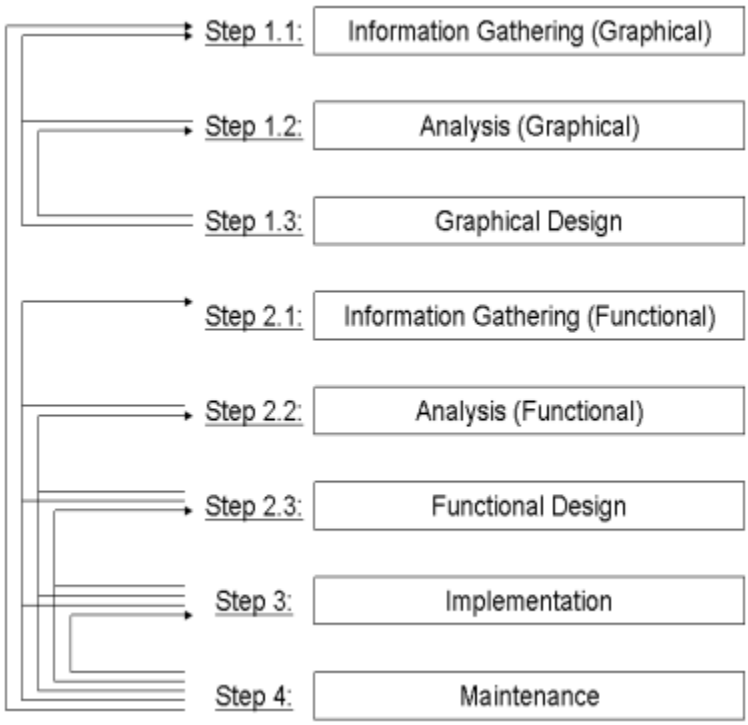

Figure 3.1: Web Development Life Cycle (Adapted from (French, 2011))

3.3.1 Information Gathering-Non-Functional Requirements (Graphical)

This first step of WDLC of information gathering is for assisting in designing the application. In this stage, the researcher gathered information aimed at assisting in creating an effective layout for the application and determining the various pages to be included. The below discussed sections further explains how the information was acquired.

3.3.1.1 Study Variables

In a study, a variable refers to a phenomenon that a researcher is trying to measure in a given way. The choice of variable is depended on the focus of study (Denscombe, 2010). We have the independent and dependent variable as the two genres of variables. A dependent variable is the variable that the researcher has an interest in. The independent variable affects the dependent variable (Kothari, 2014). For this study, the independent variable was personality type based on Myers-Briggs Personality Type Indicator and the dependent variable was the career type. Personality types was measured using the Myers and Briggs' system of personality typing**,** career type was based on Table 2.2.

3.3.1.2 Sampling Design

A researcher will select a portion from the study population so as to be able to generalise the resultant sample study results to the entire population through a process called sampling (Sachveda, 2010). Sampling process involves the target population and unit of sampling, determining the sample size of the collected data and the method used for sampling (Kothari, 2014). For this study, the researcher systematically chose the sample size. A scientific way of sampling design was utilised so as to assist in coming up with the desired study results and conclusion. The design of the sample is discussed as follows-

a. **Target population**- The target population compromised of persons who have the intention to change careers and high school students.
b. **Location of study**- The study was carried both online and offline. The online group comprised of persons with intentions of changing careers and well known to the researcher. The offline group composed of high school students from Mavoko Secondary School in Machakos County. The researcher targeted these two groups because she has established relationship with them and so they are more likely to support the effort.

c. **Sampling frame**- This is the source list from where the study sample was selected. For this study, currently enrolled students of Mavoko Secondary School and persons intending to change careers were considered.

d. **Sampling size-** According to (Kothari, 2014), any research suffers a major challenge in selecting the optimum sample size. An optimum sample size ensures that the research is satisfactorily efficient, representative, reliable and flexible. Kothari (2004) advices researchers to choose a sample size that offers an acceptable level of confidence interval and error of margin. For this study the confidence interval was 90% while the margin error was 10%.

For this research, the target population was 700 participants as per the school enrolment and number of persons willing to change careers. To statistically determine the sample size, the researcher used Raosoft Sample Size Calculator, an online sample size determination software. With a sample population of 700 respondents, confidence interval of 90%, 10% margin error and 50% Response distribution, the researcher fed all the information to the software and had it calculate the optimum sample size both scientifically and statistically. The researcher found the calculator valid because it uses a statistical formula for a sample size which is more than 30 with a normal distribution. The calculator formula is-

$$x=Z(c/100)2r(100-r)$$

$$n=N\ x/((N-1)\ E2 + x)$$

$$E=Sqrt\ [(N - n)\ x/n(N-1)]$$

Where n is the sample size, N is the population size, r is the fraction of responses that you are interested in, and $Z(c/100)$ is the critical value for the confidence level c. (Source: (Raosoft, 2004))

By the given calculation, the sample size is 62. This means that this study will use respondents equal to 62 or more.

e. **Final sample size**- A good research should be reliable (Kothari, 2014). To ensure reliability while considering the probability of some participants not responding or having the questionnaires half-filled, the researcher considered a sample size of 70 which is 10% of the target population. This estimated sample size of 70 was not the actual one that was

used for data analysis purpose. Properly filled questionnaires were considered for data analysis.

f. **Sampling technique**- in order to achieve correct and better findings, for choosing the sample size, the researcher used mixed sampling technique. For high school students, she used random sampling with judgement. To select a sample from those intending to change careers or join college she used snowball as well as convenient sampling technique. The combination of these techniques enabled the researcher to select a sample size that conveniently represents the sampling unit.

3.3.1.3 Data Collection/Instrumentation

Data is a collection of natural phenomena descriptors comprising of the results of experiment, a set of premises, experience or observation (Sachveda, 2010). It is very important to collect appropriate data since it is the authoritative source that can allow a researcher to meet the study objectives (Bajpan, 2011). After a careful consideration of study objectives, budgetary constraints, time and efforts to be expended, the most effective and efficient method should be adopted (Kothari, 2014). For this study, both primary and secondary forms of data were collected. Primary data was collected through tools like questionnaires, observations, interviews and discussions. Secondary data collection utilised methods like books, magazines or internet. However, the researcher ensured that the tool used was reliable and valid (Bajpan, 2011). To achieve the study objectives, the researcher used the below tools

a) Questionnaire

Online and printed questionnaires were used in collecting primary data. This is because they are easy to administer and track. The researcher provided questionnaire instructions and offered any assistance in answering the questions in cases where the respondents needed any clarifications. The questionnaire contained both open ended and closed ended questionnaires that assisted in collecting data and granted a better understanding of personality-career compatibility. Through the questionnaire the researcher was able to identify respondent knowledge on the subject of personality and career and also whether the respondent has ever interacted with a career recommendation system while revealing the functionalities they would want present in such a system.

The researcher carried out a pilot study with 30 high school students and 10 persons who are deliberating to change their career. The participants in the pilot study were again used in validating the accuracy of the developed system.

b) Purposive discussions

The researcher discussed relevant research aspects like personality, career, career choice, factors that influence career choice, challenges in choosing a career with school going students, corporate employees, career counsellors, those joining college or intending to change jobs.

c) Interviews

The researcher conducted online interviews as a way of understanding how career selection process is conducted while seeking to know what the participants thought about the subject of personality and careers. The respondents were allowed to give open and independent views on the process and their views in relation to personality and careers. The target interviewees were parents, career counsellors in the selected schools and even persons already in the job market.

d) Document Review

Secondary data offers guidelines for a researcher to realise their research work. Relevant literature and earlier on done studies over related topic can enrich the researchers wealth of knowledge (Bajpan, 2011). For this study, the researcher studied all the available secondary data so as to make the process more effective. She reviewed documents and books as a source of secondary data. The researcher sourced the data from academic journals, books, research reports, and the wide world web (WWW).

3.3.1.4 Data Analysis

According to (Kothari, 2014),data analysis involves operations like establishing categories, applying the categories to raw data via coding, tabulating and deducing statistical inferences. The collected data should be analysed in an appropriate manner so as to bring about the desired results. During analysis, relationships in support or conflict of the original theories are usually subjected to significance tests so as to establish the validity of data in reaching to conclusions (Bajpan, 2011).

In this study, the pilot test responses were analysed so as to establish the validity, reliability and applicability of the study. The data collected via offline questionnaire was inserted into google

forms which automatically did the analysis. The Chi-square Goodness of Fit Test was used in verifying sample distribution fitness to the population. Also, Kendall's Test was used for Hypothesis Testing to illustrate the connection between personality and Career choice of respondents. Different statistical methods like bar charts and pie charts were also used for analysis. The resultant analysed data was interpreted to simple and comprehensible formats for easy understanding while drawing general conclusions.

3.3.2 Analysis(Graphical)

This step involved the analysis of the information acquired and documenting the needs of the site design. The sitemap of navigating through the application was outlined. The researcher developed a graphical representation of the web application from which a template was developed from.

3.3.3 Graphical Design

From the documentation of the previous step, the researcher created a prototype of the application. At this point the only functionality available was the ability to navigate via the website.

3.4 Functional requirements

Requirement engineering is a crucial phase in software development that begins with the informal account of what a system is expected to do. Sadly, this phase can be easily neglected during development (Alsaleh & Haron, 2016). Therefore, there is a need to get insights into the system requirements from end user perspective. Requirement engineering involves four tasks namely, requirements elicitation, negotiation, specification and validation (Pohl, 1996). Functional Requirements is defined as the behaviour that a system must perform without giving any consideration to physical constraints. Functional requirements specify the input and output behaviour of a system (Glinz, 2007). For WDLC determining the functional requirements is a process that is achieved as follows-

3.4.1 Information Gathering (Functional)

This phase involves gathering the functional requirements like identifying the purpose of the application, the functionalities required and the application components. The information collected during the graphical phase information gathering will be reviewed. For ease of analysis, the researcher input the offline questionnaires into google forms. The resultant quantitative data was collected, checked, coded and analysed to check relevancy. The qualitative data from the

interviews was thematically analysed based on the study aspects. The resultant data was then automatically plotted using bar graphs and pie charts in google forms in a bid to get a clear presentation of the findings. From this step, the researcher was able to come up with a business model as per the study.

3.4.2 Analysis (Functional)

At this phase the researcher aims to establish the flow of business information so as to achieve specific business objectives as per the established business model. Object Oriented System Development methodology will be used in the comprehensive modelling and analysing of all the user requirements.

Unified Modelling language (UML) notation was used in modelling all the business processes. For modelling the requirements, use cases were used so as to come up with a prototype. A sequence diagram was used to show the system flow indicating how information was passed between the system entities.

Data representation was shown through database tables and Entity Relationship Diagram (ERD) showing the attributes, entities and their relationship and lastly Class diagram were used to model the classes of the entities with their respective attributes and applicable implementation methods. The different modules of the application were identified at this point.

3.4.3 Functional Design

At this stage, the researcher started creating application prototype based on the modules identified. The application source code was done in C# while the data base that was used is MSSQL server database. For knowledge acquisition the researcher used the Knowledge Acquisition and Documentation structuring (KADS) methodology. The study participants were testing the system as new functionality was being added.

3.5 Implementation

The prototype was developed from the researcher's local machine but hosted on online Apache HTTP server. The application files and database were also moved to the HTTP server for implementation.

3.6 Maintenance

The researcher will continually keep on updating the system to include modifications to existing programs based on user recommendations or technology changes.

3.7 Ethical Considerations

The research study is susceptible to ethical issues and considerations (Kothari, 2014). The researcher sought the permission of the head of the secondary school who is the custodian to the minors. The respondents were informed of the intention to involve them in the study hence the need to give their consent. They were informed that their information was to be used solely for purposes of the study and confidentiality would be maintained. In addition, all authors whose work has been cited are well acknowledged so as to avoid plagiarism.

The proposal was also submitted to Strathmore University Ethical review team for review and approval to continue with the study. The researcher also did seek approval from NACOSTI, a government institution that offers researchers permit to conduct any form of research within the country.

3.8 Dissemination and Utilization of Result

The study results will be presented to the, Faculty of Information and Technology, Strathmore University. The developed system will be given to the schools, whose students participated, so that they can use it in guiding the students on career choices before joining college. The researcher will also retain a web version of the system that he will be sharing with persons interested in trying the system. Eventually, the researcher will publish a paper on the research topic in a reputable journal for access by other researchers.

Chapter 4: System Analysis, Design and Architecture

4.1 Introduction

This chapter aims to give a thorough presentation of study findings by use of tables, bar graphs and pie charts. Such findings have been analysed from data gathered through a questionnaire and interviews. The descriptive and descriptive analysis of the data assisted the researcher in answering the research questions which led to the design of a career recommendation system based on user personality together with its architecture. To come up with a comprehensive system design, UML was used to draw the diagrams and a detailed descriptions of the diagrams is also given.

4.2 System Analysis

According to Gould (2016), system analysis allows a researcher to ascertain the detailed system requirements so as to cpme up with a comprehensive requirements specification. This process involves capturing of the user requirements and modelling them. This involve recognising the system inputs and outputs and the business rules that are needed to process system data so as to produce the required information outputs. In addition, all perfomance and security requirements are identified at this stage (Wasson, 2006). From the requirement specifications, the researcher will be able to come up with a logical model representing the needs to be produced.

4.2.1 Requirement Gathering

Data used for obtaining system requirements was collected using the questionnaire (Appendix A) created using Google forms and sent to respondents via email, for those whom the researcher could not reach in person, and in person for the high school students. Open interview was also conducted. This data needed to be analysed to give useful insights in the coming up of the application. This section shows the analysis of the data collected.

Degree of response

The researcher aimed to have a target population of at least 70 respondents but managed to collect data from 82 respondents. Of the 82, 34 of them were high school students while the remaining 48 were persons deliberating to change careers. It was important for the researcher to know the courses the respondent would wish to pursue in future (High school students) or the career they are in (for those deliberating to change careers), the factors they would consider for a given career, whether they have heard about the concept of personality and its impact on their

career. The researcher further sought to know whether the respondents had ever used a career recommendation system, which one and why and lastly the respondents had a chance to suggest the features they would have wanted to see in a career recommendation system.
Following is the analysis of the data which was gotten from the respondents.

i. Career Choices by Respondents

High school students were asked the courses they would be interested to purse. Among those mentioned it included Accounting, journalism, Business management, engineering, medicine and hospitality. Majority of them chose Engineering. Those deliberating on changing careers, as at the time of administering the questionnaire were working in fields like finance, business, engineering, teaching, nursing and IT.

ii. Factors Considered in Choosing a Given Career

Respondents were asked to indicate the factors they considered in choosing a given course or career. The charts below show the factors distribution for each group.

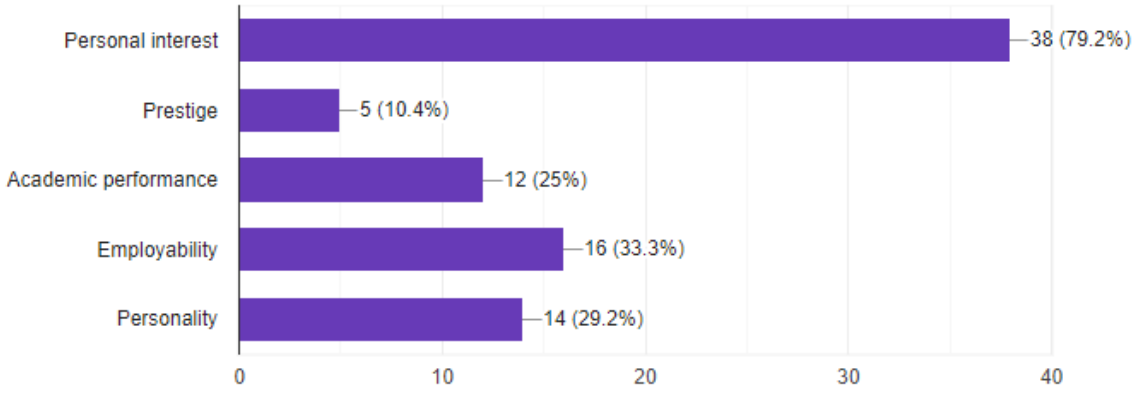

Figure 4.1 Factors deliberating individuals consider in career choice

From the chart above, it can be deduced that personal interest ranked highly in as a factor while prestige ranked lowly for both groups. Personality ranked as the third least factor among those deliberating to change careers and second least among high school students.

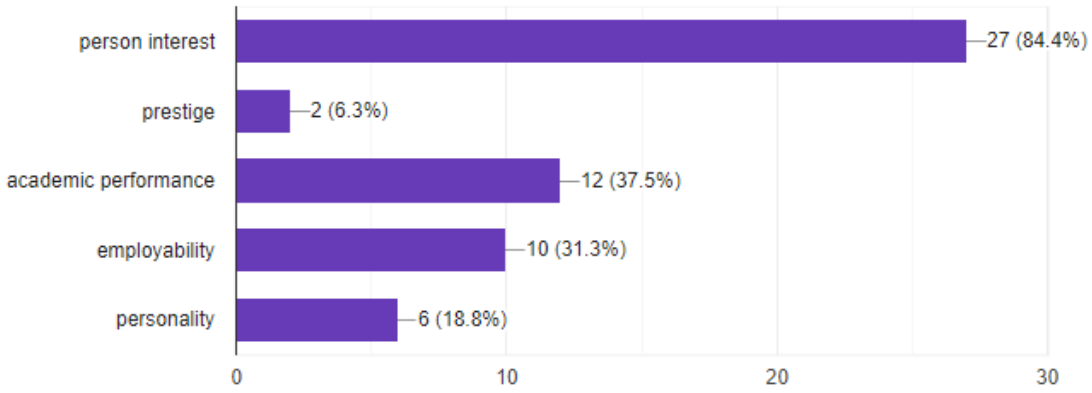

Figure 4.2: Factors high schoolers consider in career choice

From the chart above, it can be deduced that personal interest ranked highly in as a factor while prestige ranked lowly for both groups. Personality ranked as the third least factor among those deliberating to change careers and second least among high school students.

iii. Knowledge on Concept of Personality

Respondents were asked whether they had ever heard about the concept of personality. As per the charts below, 58.3 % of those deliberating to change careers and 32.4 % had heard about the concept of personality

.

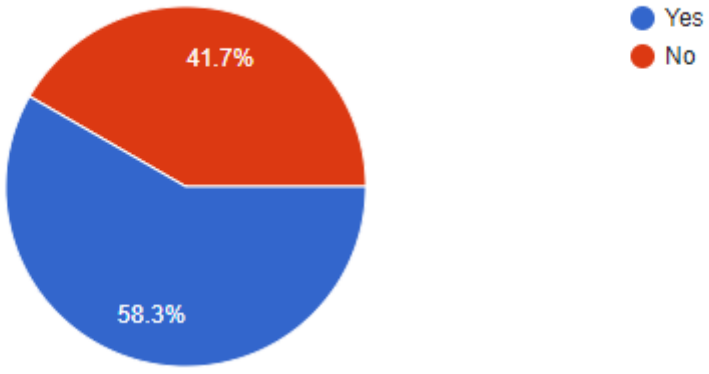

Figure 4.3: Deliberating individual's personality concept knowledge

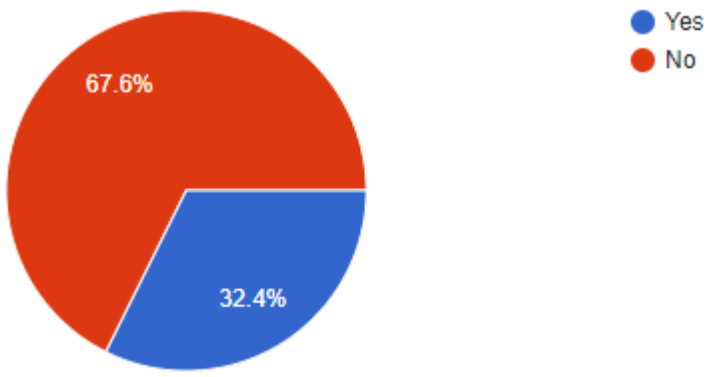

Figure 4.4: Pie chart showing high schoolers knowledge of concept of personality

When asked what they thought would be the impact of personality on their career, high school students gave these reasons as some of their answers. ‘It will help me in pursuing my career’, ‘It determines whether I can endure everything in my career’, ‘it will be of positive impact to my future career’, ‘my personality will effect on attaining my career’, ‘I will perform best in the field’, ‘Helpful in my future career’, ‘Personality will give me the strength to be persistent and work hard’, ‘it motivates me to achieve and accomplish my career’, ‘It will make me able to relate with my subject ambient’, ‘self-drive towards achievement’,’ it influences the passion and hard work in the career I will pursue’.

From the replies by the high school students, it is well evident that 45.5% of the respondents have a clear understanding of what personality can do to their career.

When those deliberating to change careers were asked on what they thought would be the impact of personality to career, the replies given included "It will help save lives’, ‘Not sure how it works’, ‘My characteristic patterns motivates me towards achieving my goals’, ‘I will be productive and have a sense of curiosity through training’, ’It's personal drive’, ‘It helps me in growth’, ‘Personality has influenced my desire for entrepreneurship and thus greater interest in business career’, ‘My personality fits great in my career’, ‘It’s important in some career aspects. It will still be very helpful, think if your path is political’, ‘It’ll make me remain focussed and confident’, ‘and relevant to my work, inspiring the students by giving them hope”, ‘it makes me feel good, confident and teach students with gratitude and patience’, ‘Outgoing and outspoken, ‘Your personality greatly determines the heights you will flourish to in your career’, ‘Enables healthy interactions with teenagers’’, ‘as an introvert they go hand in hand’, ’Career development‘,

'it can make my future career to blossom or die, 'Building up my capacity Building', 'It determine how effective you will be in your work' and fairly important.

From the replies among those who have heard about the concept of personality and deliberating to change careers, it can be deduced that they have a slight understanding of the impact. This is because only 35.7% have a clear understanding of the impact of personality to their career.

iv. Impact of Personality on Future Career

The respondents were asked whether they would like to know their personality and how it would impact their future career. From the chats below, it is evident that majority of the respondents like the idea.

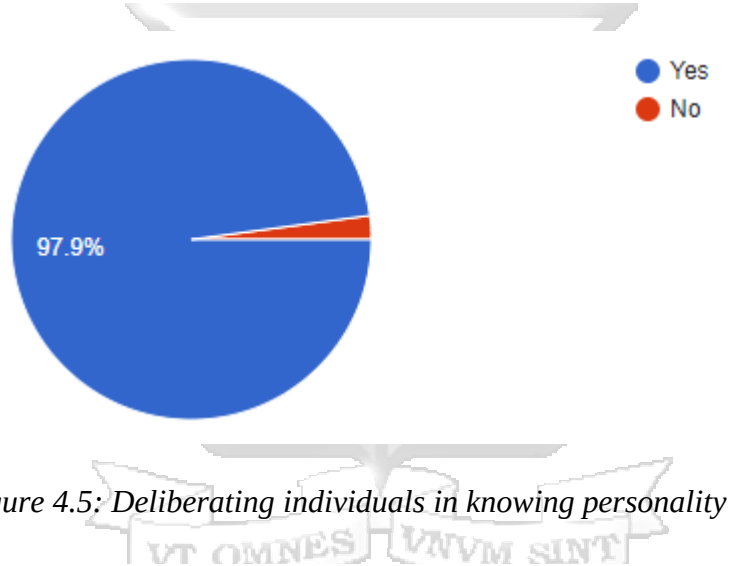

Figure 4.5: Deliberating individuals in knowing personality type

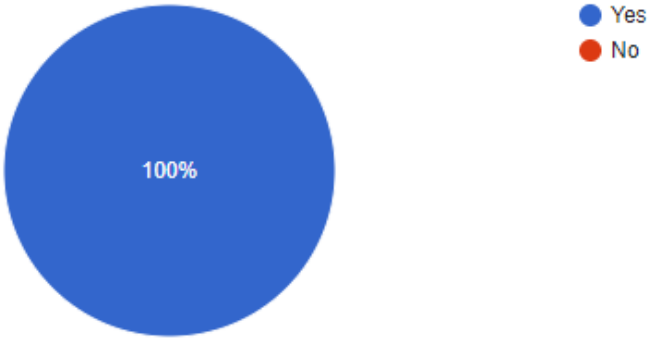

Figure 4.6: High schoolers interest in knowing personality type

From the chart, it is evident that all the high school students are interested in the concept of personality and careers

v. Use of Any Career Recommendation System

The respondents were asked if they have used any career recommendation system, 94.1% of high school students confessed to having never used any career recommendation system. 5.9% confessed to have used a system referred to as career compass.

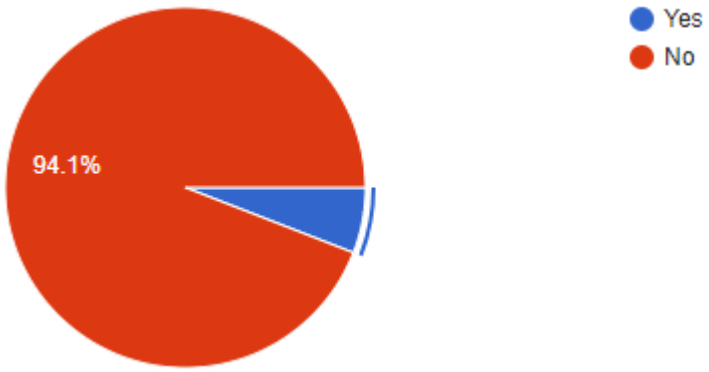

Figure 4.7: Use of career recommendation system among High School students

The students who had never used any recommendation system indicated reasons like not knowing any, lack of time, and lack of confidence as some of the reasons as per the chart below.

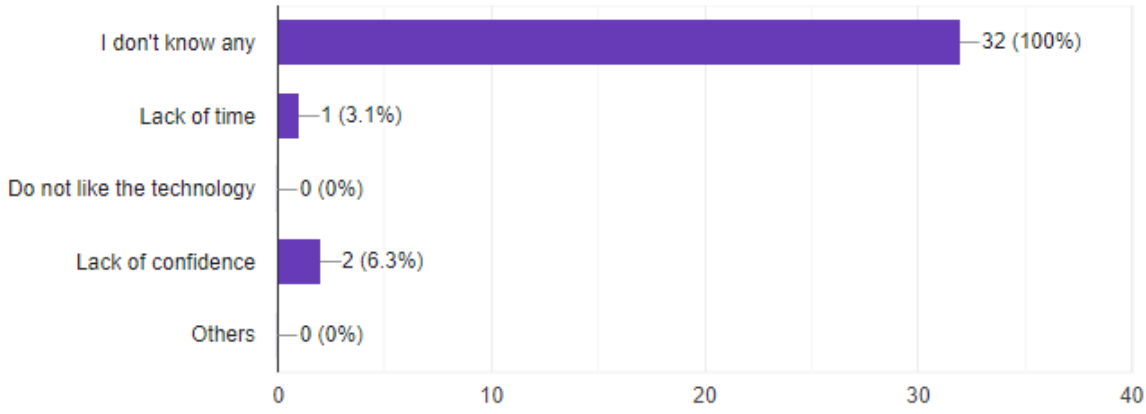

Figure 4.8: Chart depicting why high schoolers don't use career recommendation system

When asked whether they have used any career recommendation system, 79.2% of those deliberating to change careers had never used any system.

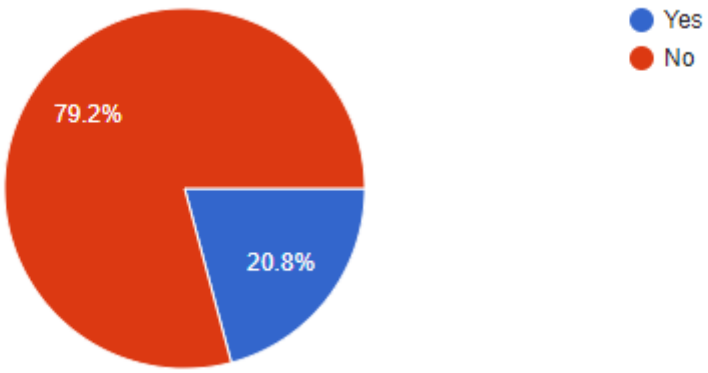

Figure 4.9: Use of career recommendation system among deliberating individuals

The students who had never used any recommendation system indicated reasons like not knowing any, lack of time, lack of confidence and other reasons not named as some of the reasons as per the chart below.

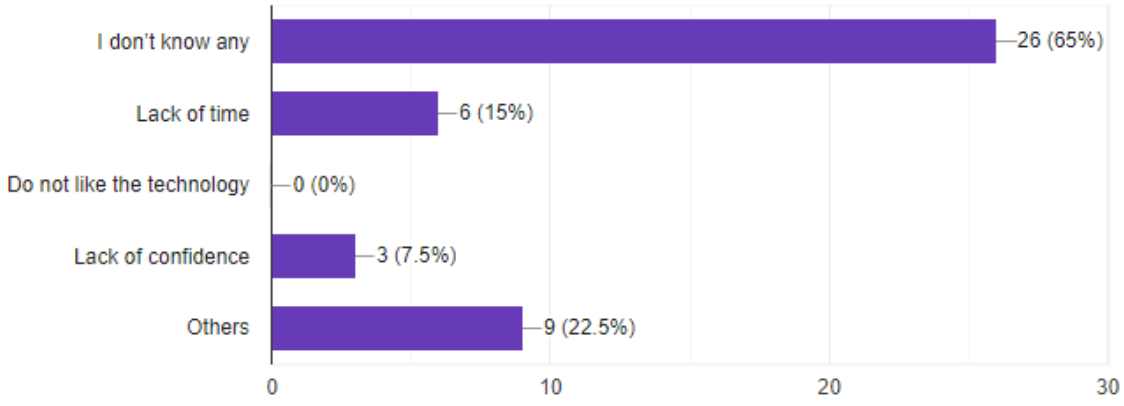

Figure 4.10 why deliberating individuals don't use career recommendation systems

As shown in Figure 4.8 and figure 4.10, it can be deduced that the respondents have not accessed any career recommendation system because they don't know any. All respondents seem to appreciate technology.

All the high school students who had used a career recommendation system said they used it because it was easy to use as shown in the figure 4.11.

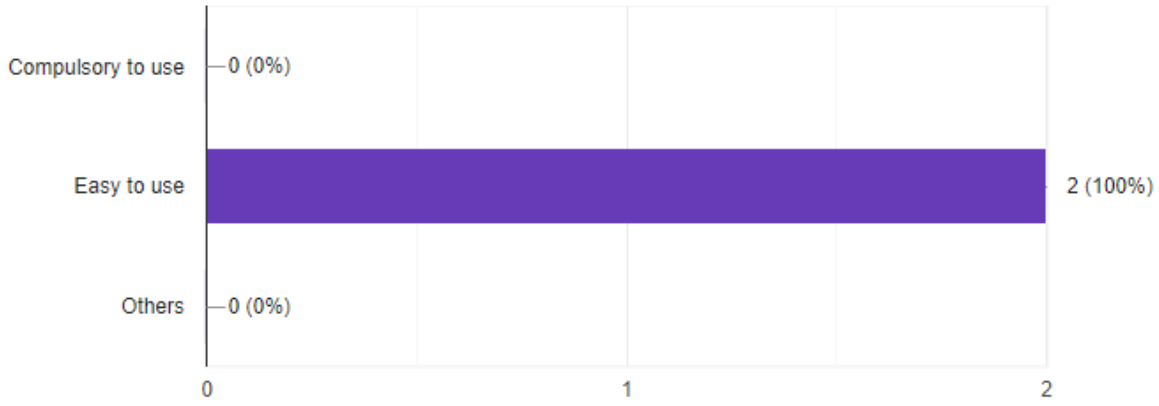

Figure 4.12: Why High school students used career recommendation system

Those deliberating to change careers used a recommendation system because it was easy to use and it was also compulsory for them to use it as per figure 4.12

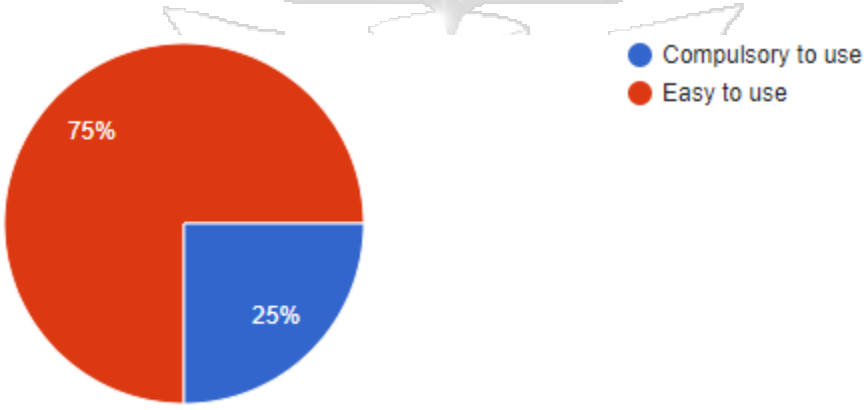

Figure 4.12: Chart showing why deliberating individuals used career recommendation system

vi. Mode of Access to Career System

Respondents were asked their preferred gadget in accessing a career recommendation system. Smart phone came out as the preferred gadget in both groups of respondents.

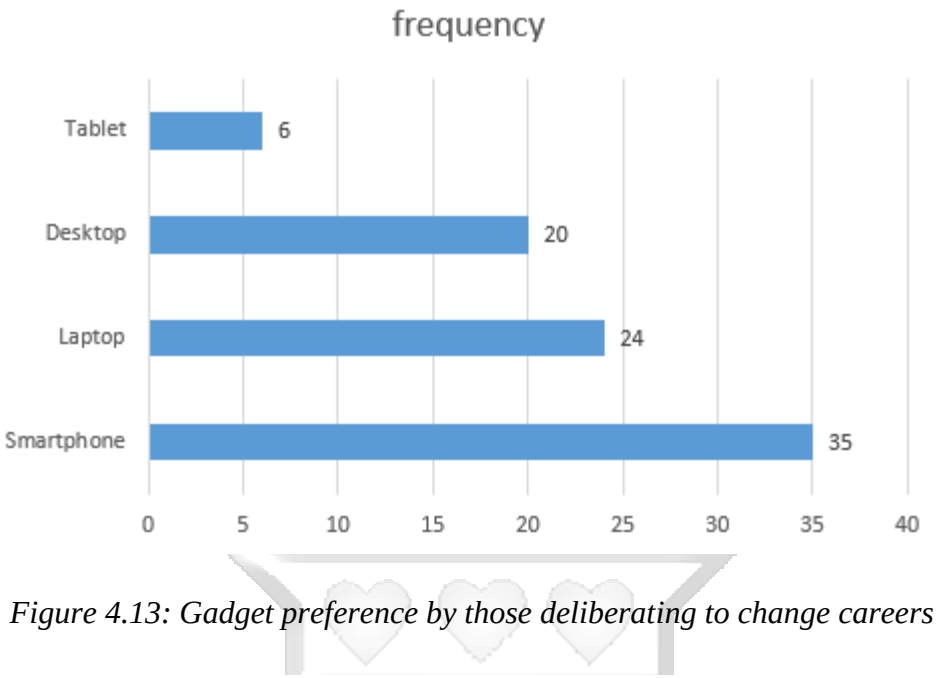

Figure 4.13: Gadget preference by those deliberating to change careers

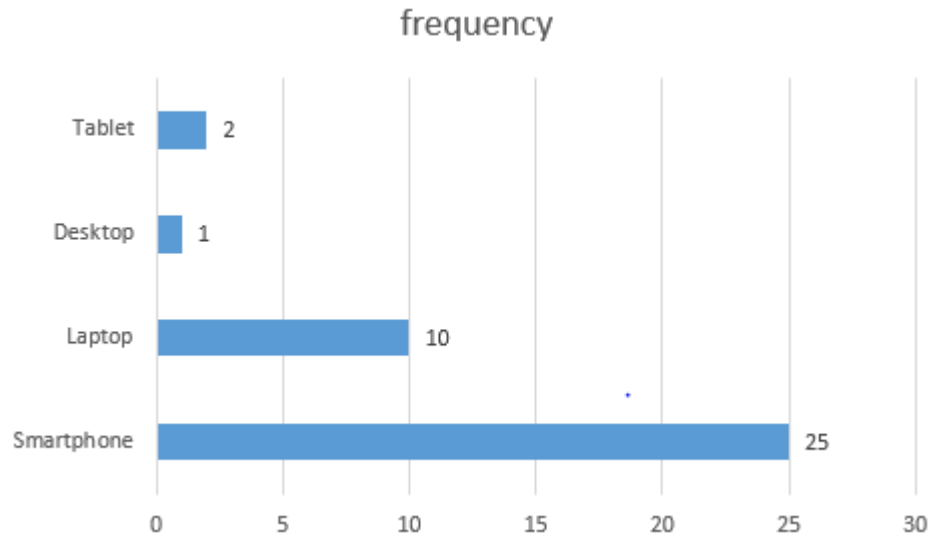

Figure 4.14: Gadget preference by High school Students

4.2.2 Functional Requirements

During the interview and questionnaire administration, the researcher sought to know the functionality the respondents would have liked a personality based career recommendation system to have. The functional requirements that the researcher came up with included: -

i. Ability to login to the system
ii. Ability to take MBTI test
iii. System should be able to suggest your personality

iv. System should be able to recommend relevant career based on personality and

v. System should be able to recommend areas for improvement

vi. Ability to share recommendation reports

4.2.3 Non- functional Requirements

The non-functional requirements identified for the system included: -

i. Friendly usability

ii. Timely feedback

iii. Security

iv. Reliability

4.2. 4 Requirements Analysis Conclusions

The replies from the respondents were greatly valuable and very enlightening to the researcher in determining whether the system she endeavoured to develop was feasible. The researcher fine-tuned the system characteristics based on the feedback she received from the respondents. From what was gathered, the researcher realised a mobile application was more preferred as compared to a web application.

4.3 System Architecture

The architecture used for the system is based on client-server architecture. With this form of architecture, available computing resources can share data processing loads while letting the client machine to offer a user with collaboration services and application processing as the server machine offers data processing services.
The client side consists of a web application which contains MBTI personality test questions that respondents will be required to answer. The score from the test will be used to determine the respondent personality then recommend suitable career to the respondent while offering the option to receive the report on email.

The web client will be connected to an online server through the internet. The server will request information from an online database where the users and career details resides. The server

will then remit responses to the web client based on information fetched from the database. Figure 4.15 illustrates the client- server architecture that will be adopted for this study.

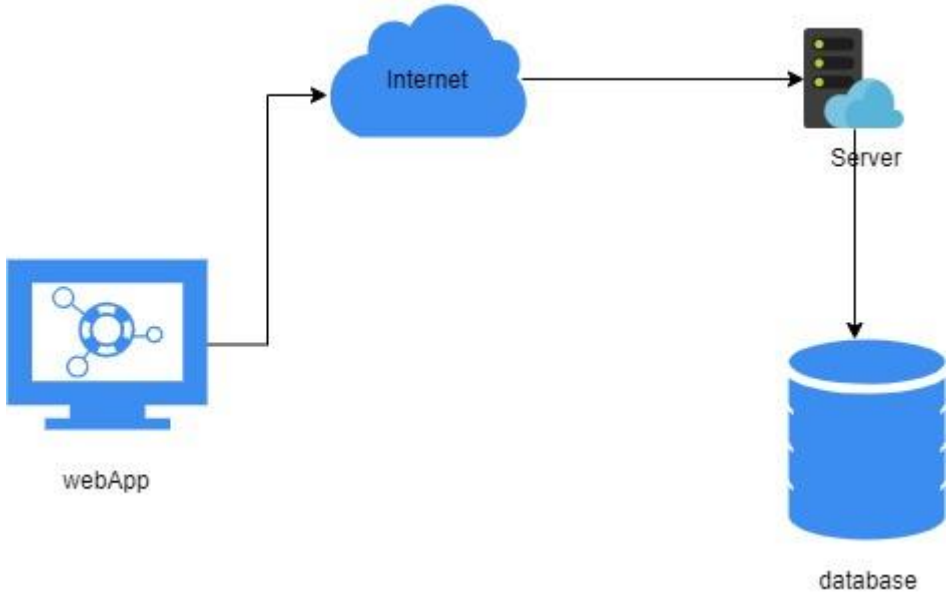

Figure 4.15: System Architecture

4.4 System Design

In developing the system design, the researcher combined ideas from requirement gathering phase, analysis and his own ideas in coming up with a system that meets the functional, non-functional requirements and research objectives. To come up with the design diagrams, the researcher adopted the Object Oriented System Analysis Development methodology as follows; -

4.4.1 Use Case Diagram

The actors for the system include a user who can be a student or person who is interested in getting a career recommendation and the system administrator who maintains the system.

The general use cases identified by the researcher from the requirements are shown in figure 4.16.

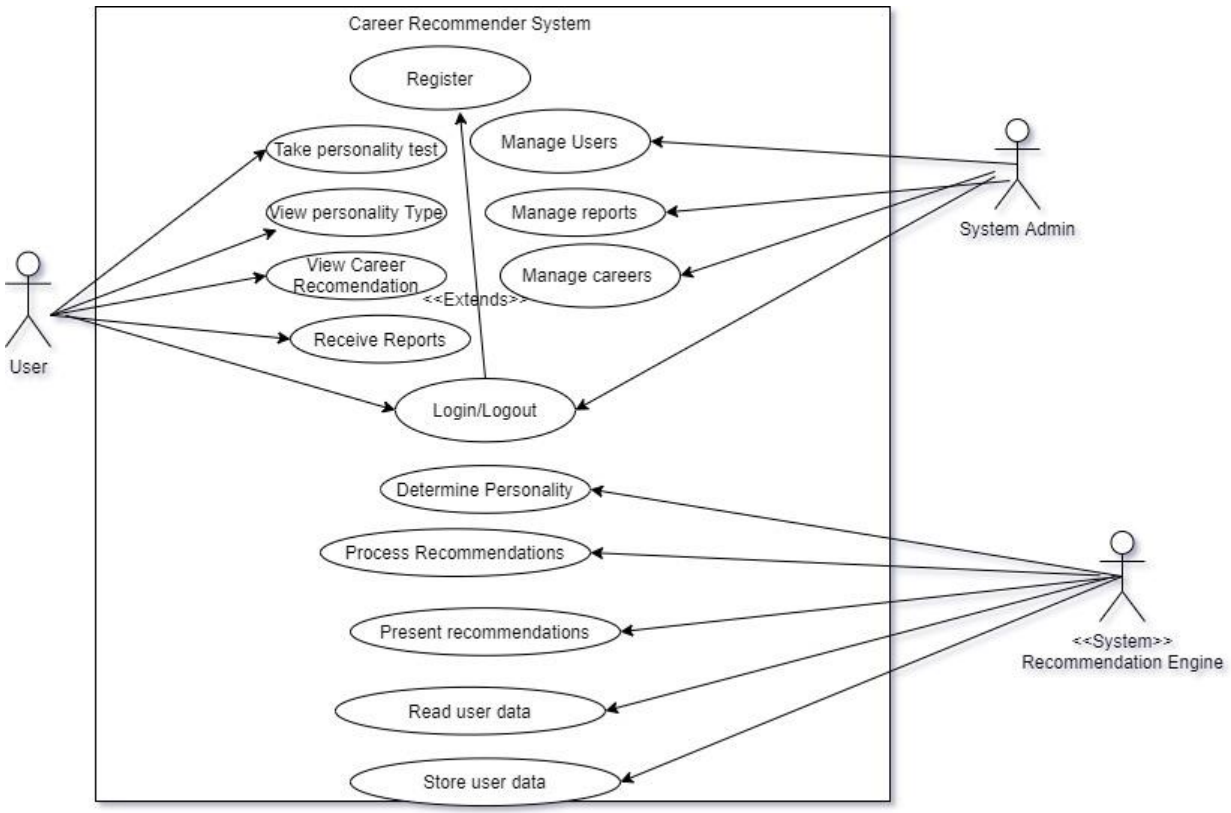

Figure 4.16: Use case Diagram

The use cases from figure 4.15 are expounded as follows: -

Table 4.1: Use case take personality test

Use case Number	UC-1
Use case Name	Take personality test
Use case Description	User takes personality test
Primary Actor	User
Precondition	User is registered on the system
Post condition	user can view his personality report
Basic Flow	1. User logs into system 2. User answers personality test questions

3. System looks up current user in data store and presents the resultant personality

Table 4.2: Use case view personality test

Use case Number	UC-2
Use case Name	View Personality type
Use case Description	User views his resultant personality
Primary Actor	User
Precondition	User has taken personality test
Post condition	System display user personality
Basic Flow	1. User logs into system 2. User answers personality test questions 3. System looks up current user in data store and presents the resultant personality

Table 4.3: Use case view Career Recommendation

Use case Number	UC-3
Use case Name	View career Recommendation
Use case Description	User views the career that fits his personality type
Primary Actor	User
Precondition	Personality of user is already known
Post condition	User can view the best career fit

Basic Flow	1. User logs into system 2. User answers personality test questions 3. System looks up current user in data store and presents recommended career

Table 4.4: Use case receive reports

Use case Number	UC-4
Use case Name	Receive Reports
Use case description	User can view his recommendation report on email
Primary Actor	User
Precondition	User inputs their preferred email address System has determined user personality and career fit
Post condition	User receives his report on email
Basic Flow	1. User requests for email report submission 2. System forwards pdf report to user

Table 4.5: Use case read user data

Use case Number	UC-5
Use case Name	Read user data
Use case description	The system reads raw user data
Primary Actor	System
Precondition	System is connected to the internet

Post condition	Data is read from a data store
Basic Flow	1. System connects to the data store and requests the data it requires 2. The data store returns the required data

Table 4.6: Use case store user data

Use case Number	UC-6
Use case Name	store user data
Use case description	The system will store the user information in data store
Primary Actor	System
Precondition	System is in update recommendation state System has determined the recommended career
Post condition	User information is stored in data store
Basic Flow	1. System gets recommendations from intermediary storage 2. System writes recommendation into data store

Table 4.7: Use case determine personality

Use case Number	UC-7
Use case Name	Determine personality
Use case description	The system evaluates user test and comes up with personality
Primary Actor	System

Precondition	System is connected to the internet
Post condition	User is presented with personality
Basic Flow	1. User takes test 2. System evaluates the test replies 3. Resultant personality is arrived at

Table 4.8: Use case process recommendation

Use case Number	UC-8
Use case Name	Process recommendation
Use case description	The system matches personality to relevant career
Primary Actor	System
Precondition	System is connected to the internet Personality type is already determined
Post condition	User can view the recommended career from data store
Basic Flow	1. System retrieves recommendation from data store 2. System matches personality with appropriate career

4.4.2 Sequence Diagram

A system sequence diagram shows the flow of information within the system. Figure 4.16 gives the sequence diagram for the career recommendation system.

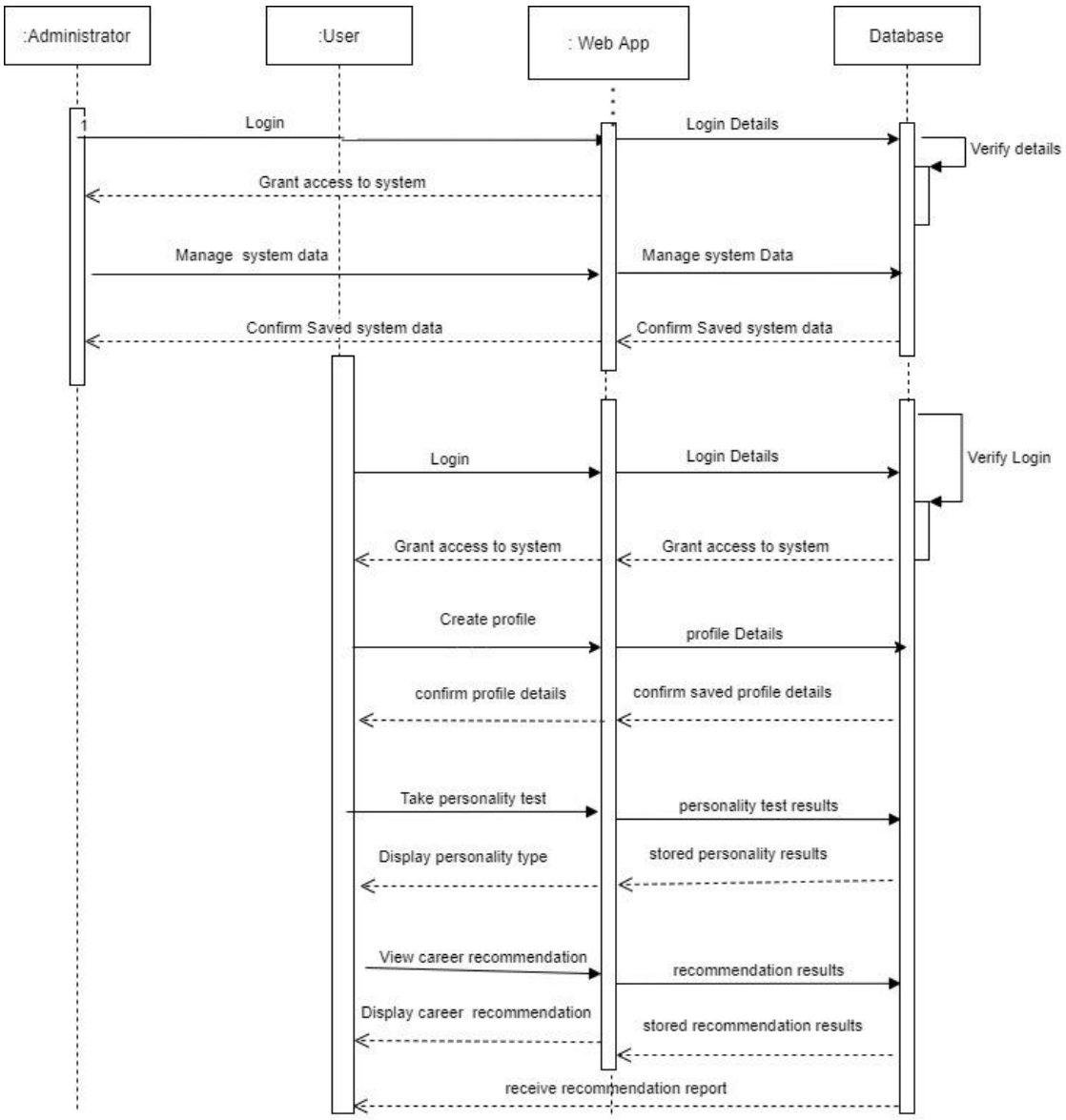

Figure 4.17: System Sequence Diagram

4.4.3 Database Schema

A database schema is the database layout that shows how data is organised into table structures. In relational databases, the schema includes the tables, fields and the existing

relationship between the tables and fields as shown in the following tables and Entity Relationship Diagram.

4.4.3.1 Database Tables

The tables making up the system are illustrated as follows: -

Table 4.9: Questions table

Field Name	Data Type	Null	Comments
id	int	No	Pk
Question	varchar	No	
Category id	int	No	FK

Table 4.10: Answers table

Field Name	Data Type	Null	Comments
id	int	No	Pk
Answer	varchar	No	
Score	int	No	

Table 4.11: Careers table

Field Name	Data Type	Null	Comments
id	int	No	Pk
CareerName	varchar	No	
MBTItypeid	int	No	FK

Table 4.12: MBTI Type table

Field Name	Data Type	Null	Comments
id	int	No	Pk
MTBI	varchar	No	
MBTIScore	int	No	

Table 4.13: Career Advices

Field Name	Data Type	Null	Comments
id	int	No	Pk
MBTITypeid	int	No	FK
Advice	varchar	No	

Table 4.14: Personality users

Field Name	Data Type	Null	Comments
id	int	No	Pk
username	varchar	No	
Email	varchar	No	
pass	varchar	No	
createdate	datetime	No	
nickname	varchar	No	
lastlogin	date	No	

Table 4.15: Results table

Field Name	Data Type	Null	Comments
id	int	No	Pk
userid	int	No	FK
MBTITypeID	int	No	FK
datecreated	datetime	No	

Table4.15: MBTI category table

Field Name	Data Type	Null	Comments
id	int	No	Pk
CategoryName	varchar	No	

4.4.3.2 Entity Relationship Diagram

An entity relationship diagram is a graphical representation of objects and the relationships existing among them. For this study, an entity relationship diagram is used to illustrate a conceptual view of the database modules as illustrated in figure 4.17

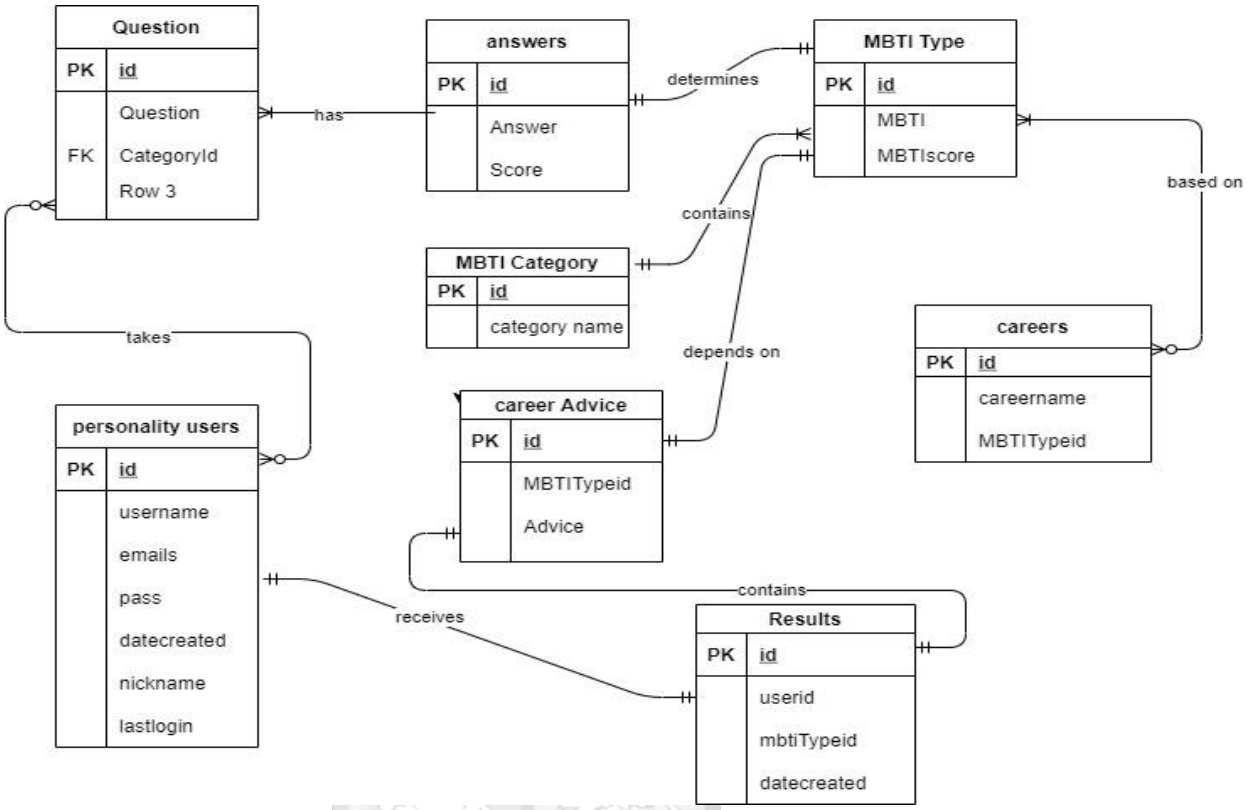

Figure 4.18: System ERD diagram

4.4.4 Class Diagram

Class diagram depicts the various entities involved in the system, their attributes and corresponding methods that apply to each class. The web application class diagram is as figure

4.19

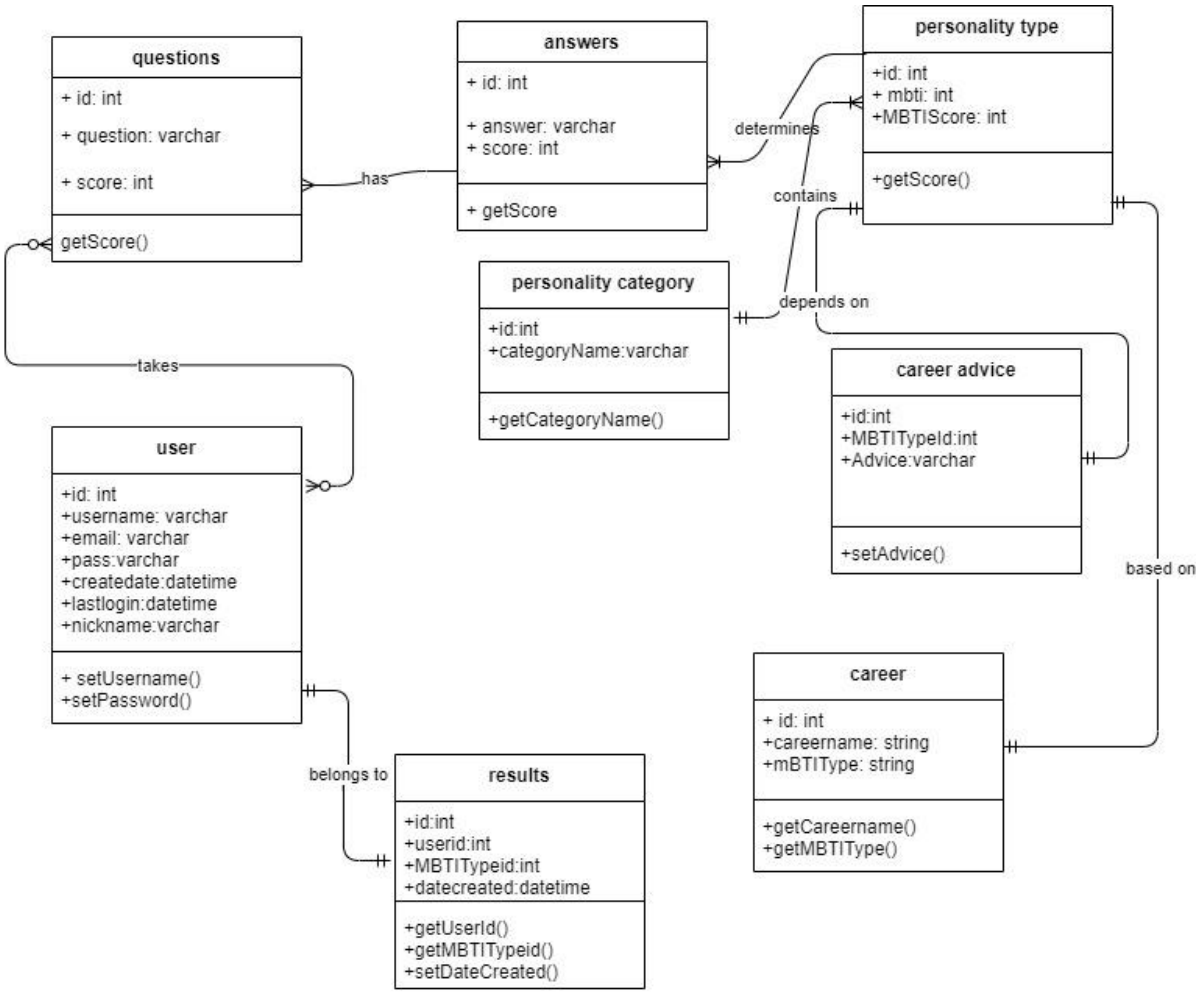

Figure 4.19: System class diagram

4.4.5 System Wireframes

The system wireframes present a visual guide exhibiting the design framework of the web application. The represented wireframes will show the arrangement of page elements bringing about clarity while working on the interactions and layout needs.

4.4.5.1 Home Page Wireframe

Home page wireframe is a design of the welcome and login page. It's a mock-up of where the user will set up their profile or sign in from when revisiting the page.

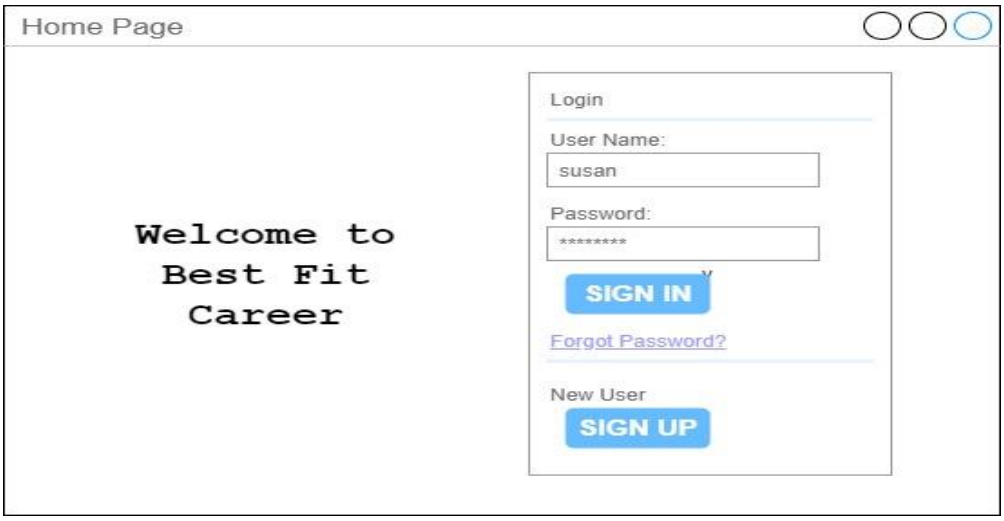

Figure 4.20: Home page wireframe

4.4.5.2 Take Test Page Wireframe

The take test wireframe shows the take test page. It shows how the questions and answers will be placed in the application. The wireframe also shows a submit button. When a user clicks on the submit button, the recommendation engine calculates the personality score, classifies it among the sixteen groups and assigns the right career fields as per MBTI career classification table

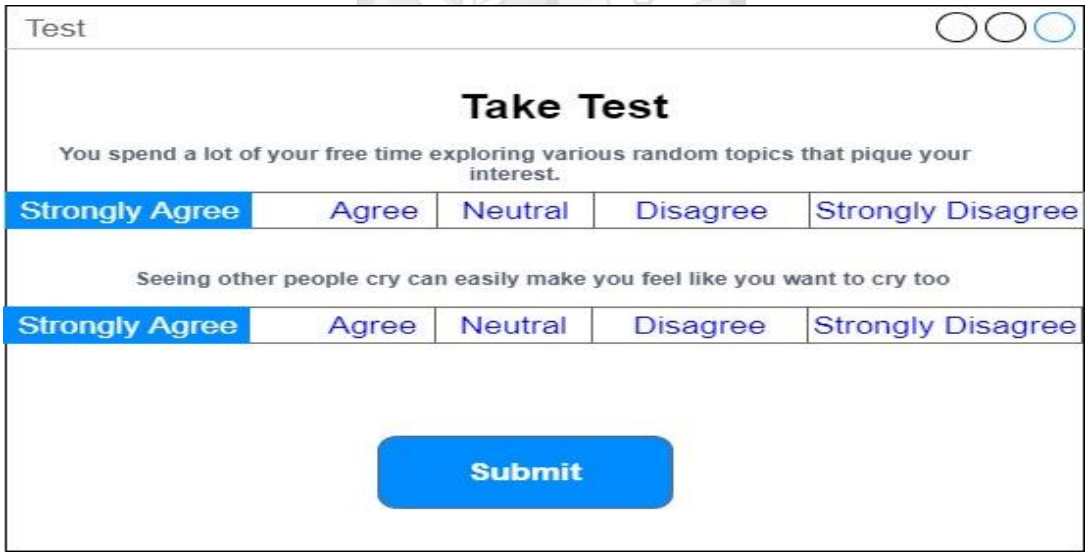

Figure 4.21: Take test page

4.5.2.3 Recommendation Page Wireframe

The recommendation page is where the results of the system are displayed. From this page the user will be able to view their personality, know what their personality is all about, the personality strengths, recommended career fields and areas in which the user can improve on. From this page, a user is able to request for email report of the recommendations.

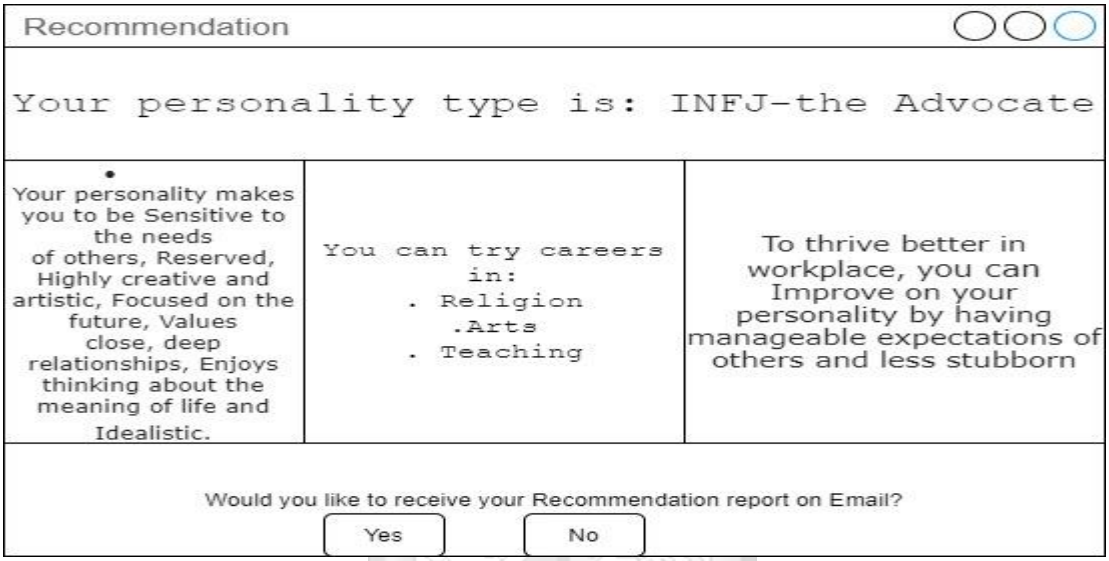

Figure 4.22: Recommendation page wireframe

Chapter 5: System Implementation and Testing

5.1 Introduction

After establishing the close relationship between personality and career choice, the researcher aims to come up with an automatic personality classification system which utilises data mining techniques in predicting personality then recommending best career fit for users. The system makes use of KNN algorithm and MBTI 16 personality types together with data mining to get user characteristics data so as to learn from the realised patterns.

This learning will then form the basis of user personality classification. The system will analyse user characteristics based on how the test questions are answered and based on the patterns observed it will store the user characteristic patterns in the database. The system will then be able to predict user personality and recommend a relevant career based on personality and career data which is kept on the database as per the classification of previous data. Every user will be required to register into the system and then login using their username and password. After Login, the user will be able to take the MBTI test. The consists of 16 questions. After submitting the survey answers, the system on the recommendation page allows the user to view their personality type, personality strengths, weaknesses and most preferred career.

This chapter aims to expound on how the system was implemented and tested so as to check whether the research objectives have been met.

5.1.1 Model development

The researcher used a dataset from kaggle which is made of tweets tagged with one of the 16 MBTI types. The tags are a combination of four characters. Each of the character corresponds to the first or second letter of the traits that make up the four MBTI classes. The dataset has 8660 rows with the MBTI traits distributed as Introversion(I): 6664; Extraversion(E): 1996, Sensing(S): 7466; Intuition(N): 1194, Thinking(T): 4685; Feeling(F): 3975, Judging(J): 5231; Perceiving(P): 3429.

In preparing the data for analysis, the researcher performed pre-processing tasks which included the removal of Hyperlinks, numbers and punctuations from tweets.

```
def preprocess_text(df, remove_special=True):
    texts = df['posts'].copy()
    labels = df['type'].copy()

    #Remove links
    df["posts"] = df["posts"].apply(lambda x: re.sub(r'https?:\/\/.*?[\s+]', '', x.replace("|"," ") + " "))

    #Keep the End Of Sentence characters
    df["posts"] = df["posts"].apply(lambda x: re.sub(r'\.', ' EOSTokenDot ', x + " "))
    df["posts"] = df["posts"].apply(lambda x: re.sub(r'\?', ' EOSTokenQuest ', x + " "))
    df["posts"] = df["posts"].apply(lambda x: re.sub(r'!', ' EOSTokenExs ', x + " "))

    #Strip Punctation
    df["posts"] = df["posts"].apply(lambda x: re.sub(r'[\.+]', ".",x))

    #Remove multiple fullstops
    df["posts"] = df["posts"].apply(lambda x: re.sub(r'[^\w\s]','',x))

    #Remove Non-words
    df["posts"] = df["posts"].apply(lambda x: re.sub(r'[^a-zA-Z\s]','',x))

    #Convert posts to lowercase
    df["posts"] = df["posts"].apply(lambda x: x.lower())

    #Remove multiple letter repeating words
    df["posts"] = df["posts"].apply(lambda x: re.sub(r'([a-z])\1{2,}[\s|\w]*','',x))

    #Remove very short or long words
    df["posts"] = df["posts"].apply(lambda x: re.sub(r'(\b\w{0,3})?\b','',x))
    df["posts"] = df["posts"].apply(lambda x: re.sub(r'(\b\w{30,1000})?\b','',x))
```

Figure 5.1 Code for data pre-processing

To help in improving the accuracy of the model, the researcher ensured that he removed the MBTI type column from the dataset as shown in the code below

```
#Remove MBTI Personality Words
    if remove_special:
        pers_types = ['INFP' ,'INFJ', 'INTP', 'INTJ', 'ENTP', 'ENFP',
                      'ISTP' ,'ISFP' ,'ENTJ', 'ISTJ','ENFJ', 'ISFJ' ,
                     'ESTP', 'ESFP' ,'ESFJ' ,'ESTJ']
        pers_types = [p.lower() for p in pers_types]
        p = re.compile("(" + "|".join(pers_types) + ")")

    return df
```

Figure 5.2: Code removing the MBTI type

The researcher divided the data into training and testing data in the measures of 70% and 30% respectively. In classifying the personality type K- nearest neighbour classification algorithm was used because it is easy to understand and implement. As a lazy learning algorithm it takes less time to compute while training as compared to fast-learning algorithm. The steps in KNN are as indicated: -

1. Estimate K.

2. Evaluate distance `between sample input and training samples.

3. Categorise the distances.

4. Clasp highest K-closest neighbour.

5. Select the most efficient and the nearest value.

6. Identify class label for input sample with more neighbour.

7. For KNN algorithm, the Euclidean distance that helps to find the distance between the sample test and closest distance is calculated as:

Given points (e1, f1) and (e2, f2) in a 2- dimensional space, then Euclidean distance between them is given as

$$x = \sqrt{((e2 - e1)^2 + (f2 - f1)^2)}$$

To generate a model, the responses were kept in a database according to the personality test that the user takes and the algorithm is used to group the reactions into a collection of non-covered personality types by tracking the most average personality type. The resultant personality type will be accurate about the user's personality.

```
# Individually training each mbti personlity type
for l in range(len(personality_type)):

    Y = list_personality[:,l]

    # split data into train and test sets
    X_train, X_test, y_train, y_test = train_test_split(X, Y, test_size=0.33, random_state=7)

    # fit model on training data
    model = KNeighborsClassifier(n_neighbors = 2)  # n_neighbors means k
    model.fit(X_train, y_train)

    # make predictions for test data
    y_pred = model.predict(X_test)

    predictions = [round(value) for value in y_pred]
```

Figure 5.3: Code for KNN MBTI model

5.2 System Implementation

The Web application was created on dot net framework. C# was used in writing the application source code. Compilation and testing of the system was done using the Visual studio. Microsoft SQL(MSSQL) database management system was used as the database to store system data for the application and hosted on Microsoft Azure.

The application has been implemented in such a manner that it meets all the system requirements identified during requirement gathering as stipulated in section 4.2.2 and 4.2.3. Internet connection is required for the user to access portal. Users are required to login in using username and password. The system will validate user credentials suppled and determine whether to redirect to landing page or throw respective error. If user is new, the system will redirect user to personality test page where user will be required to answer all questions. If user is existing, the system will redirect user to user results with option of retaking personality test.

5.2.1 System Components

The career recommender system has the listed components.

5.2.1.1 Application Home Page

As shown in figure 5.4, the homepage is the first page from which application user can navigate to other pages. From the homepage the user is able to sign into the system from which after

successful login in he/she is redirected to test page. This component allows the researcher to meet the user requirement as per respondent suggestions specifically, the system should “allow user to login to the system”.

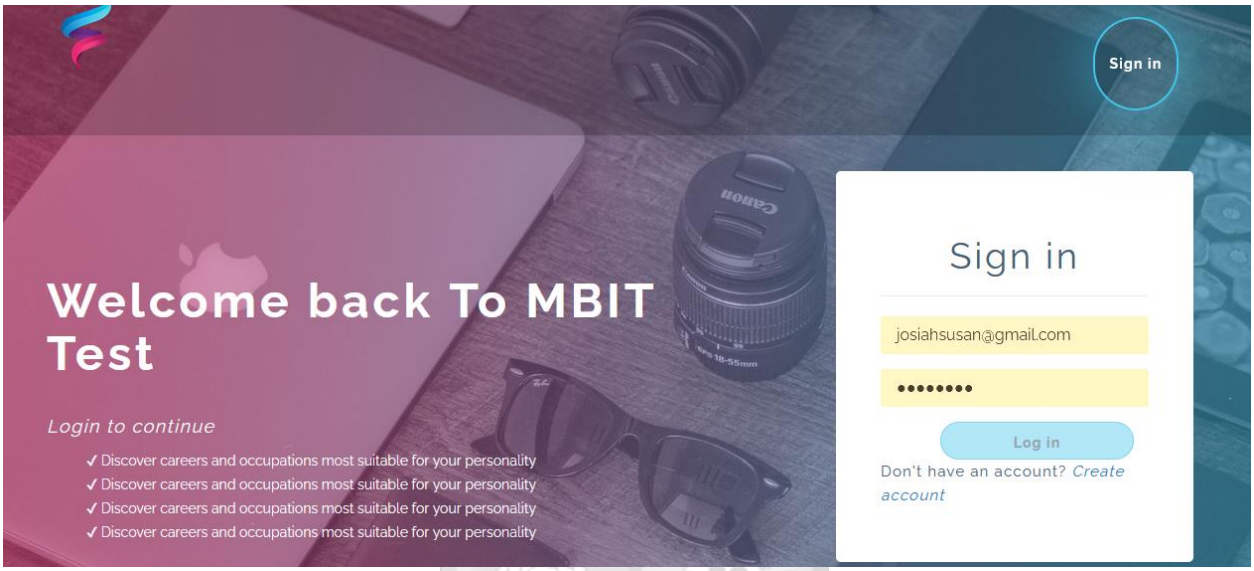

Figure 5.4: Best Career Fit - Home page

5.2.1.2 MBTI personality test page

This is the page that contains the test questions that a user needs to choose answer from the options given so as to arrive to a personality type. Each question has answer with choices ranging from strongly agree, agree, neutral, disagree and strongly disagree. A user has to choose either of the five choices as an answer. Once a user is done with one part of the questions, they can use next button to navigate to the next page till they are done with the test. Sample questions are shown in figure 5.5. The user requirement that this page specifically fulfils is the system should allow user to take MBTI test.

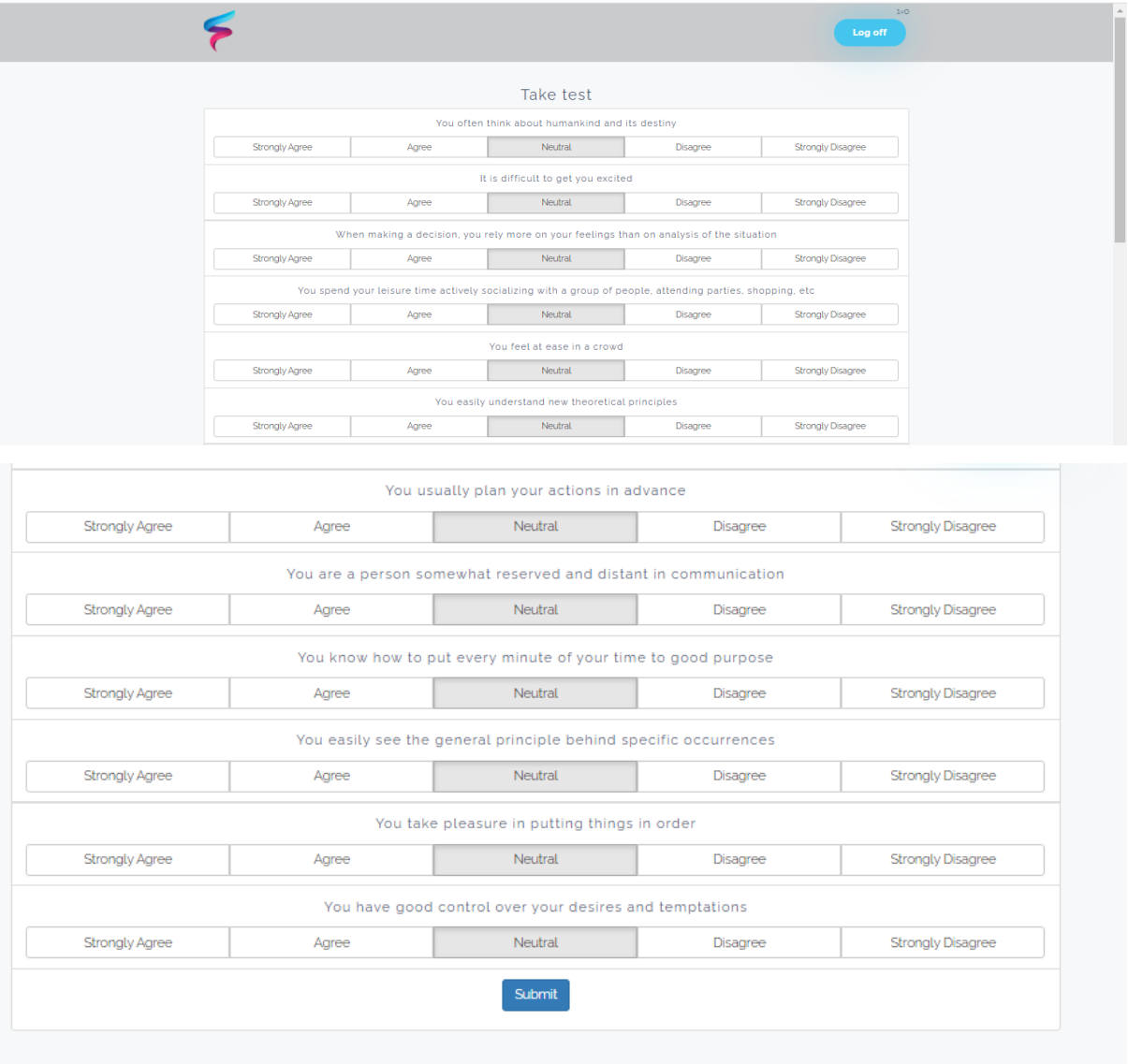

Figure 5.5: Take test Page

5.2.1.4 Recommendation Page.

This is the page that displays the system recommendation. From this page, the researcher has fulfilled the user requirement “System should be able to recommend relevant career based on personality”, “System should be able to recommend areas for improvement”, “Ability to share recommendation reports” and “allow user logoff system”.

After taking the test and submitting the choices, the system is able to arrive to a resultant personality. The resultant personality with a brief explanation is displayed for the user to view.

From the identified personality, the system is able to the match this personality with the best fit career options as indicated in Table 2.2 and display the same to the user. The system is then able to advice the user on areas of improvement in their personality so as to thrive better in the workplace. Lastly, the user is able to choose whether to receive a report of their recommendations or not.

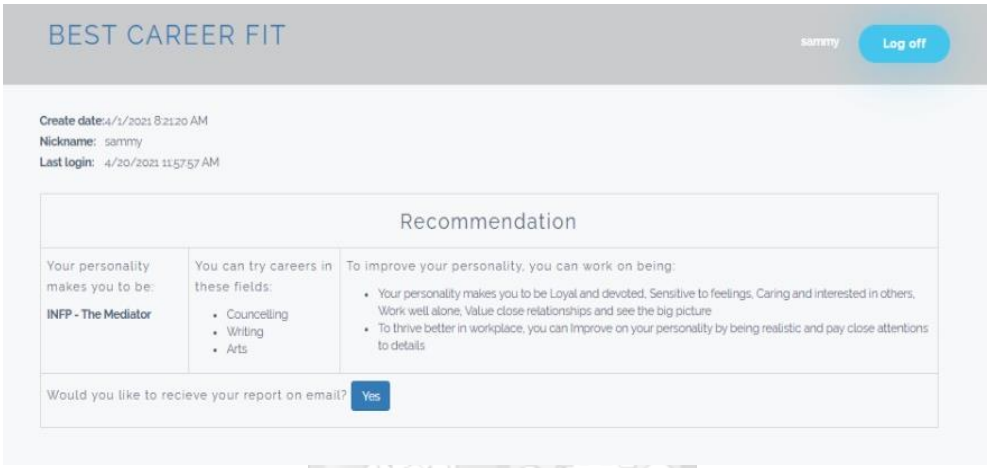

Figure 5.6: Recommendation Page

5.2.1.5 Administrator Login Page

The web application is composed of an administration portal from which the system h/admin is able to log into the system and perform the below activities: -

a. Manage data
b. Manage the database

To be able to log into the system, the administrator credentials have already been set and so the admin has to login using them. Figure 5.7 is a snapshot of the administrator login page. After login from this page, the admin will be able to go to the administrator portal from where he can manage the system data and database. After doing all the management, the administrator can as well log off the system from the portal.

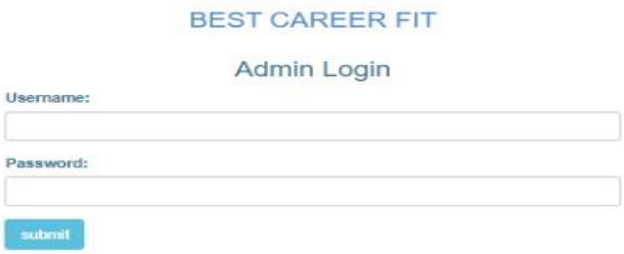

Figure 5.7: Admin Home Page

5.2.1.5 View Users Page

As an administrator, it is important to be able to know who uses the system and how often so as to gauge the popularity of the system. From the user's page as indicated in Figure 5.8, the administrator can view the users name, their email, when they created their profile, their details and even the recommendations produced by the system. This is very helpful in cases where an administrator is a career counsellor or master in that they can best know how to assist their client to make the best decision owing to the challenges they are experiencing at the time.

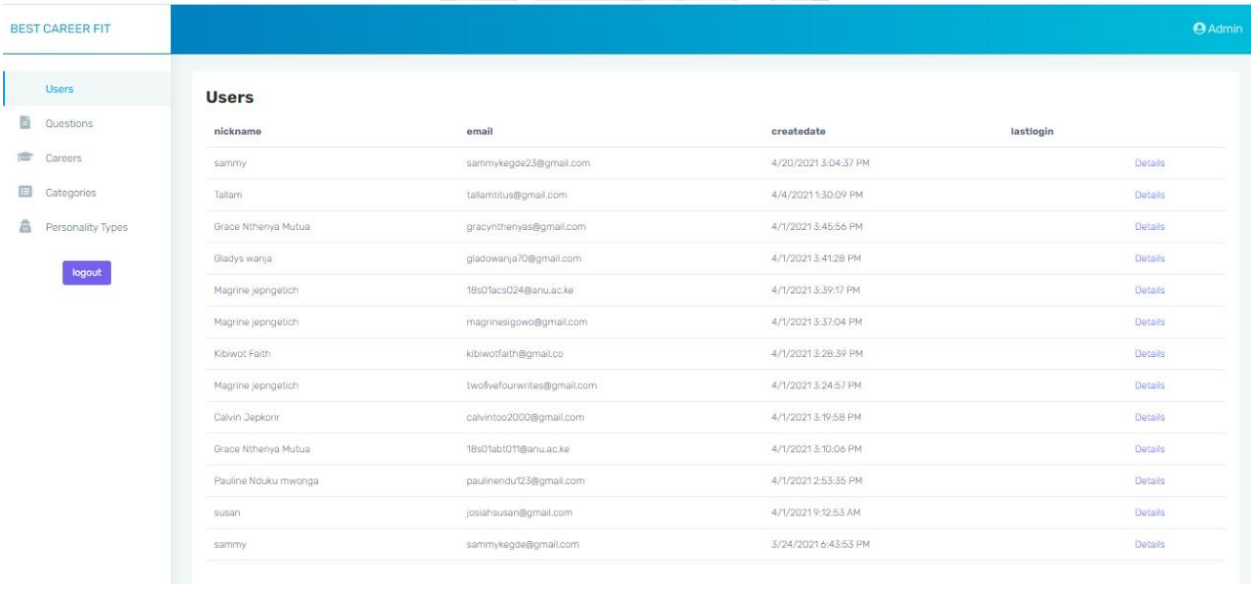

Figure 5.8: View Users page

5.2.1.6 Admin Career page

Since there is no definite test and a test can contain any number of forced questions as the one administering the questions deems fit. Figure 5.9 gives us some of the sample questions that users of 'Best Career Fit' system can take. From this window, an administrator can be able to add more questions and clarify their category. The administrator can also edit or delete existing questions. It's from this window where the administrator can modify all about questions.

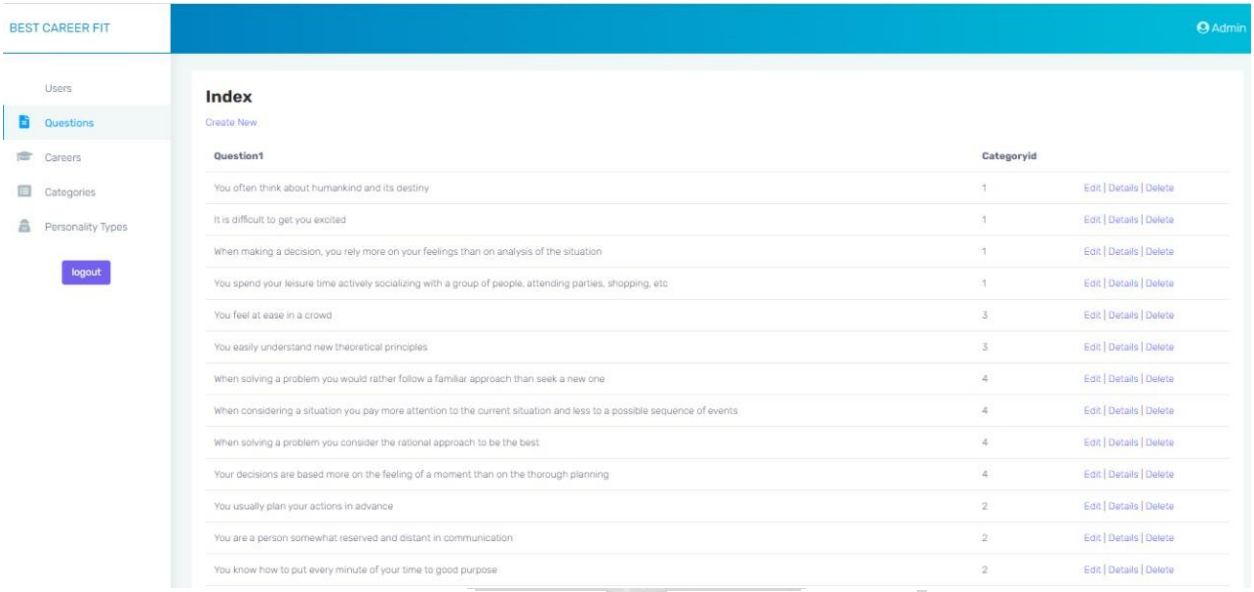

Figure 5.9: View questions page

5.2.1.7 Administrator View Career Page

With the evolution of technology and changing times, careers are deemed to change with new fields emerging while others become obsolete. To keep up with the changing times, the administrator from the page indicated in Figure 5.10 can be able to add new careers, edit and delete existing careers. All the careers are tied to a MBTI personality type which the administrator has to specify.

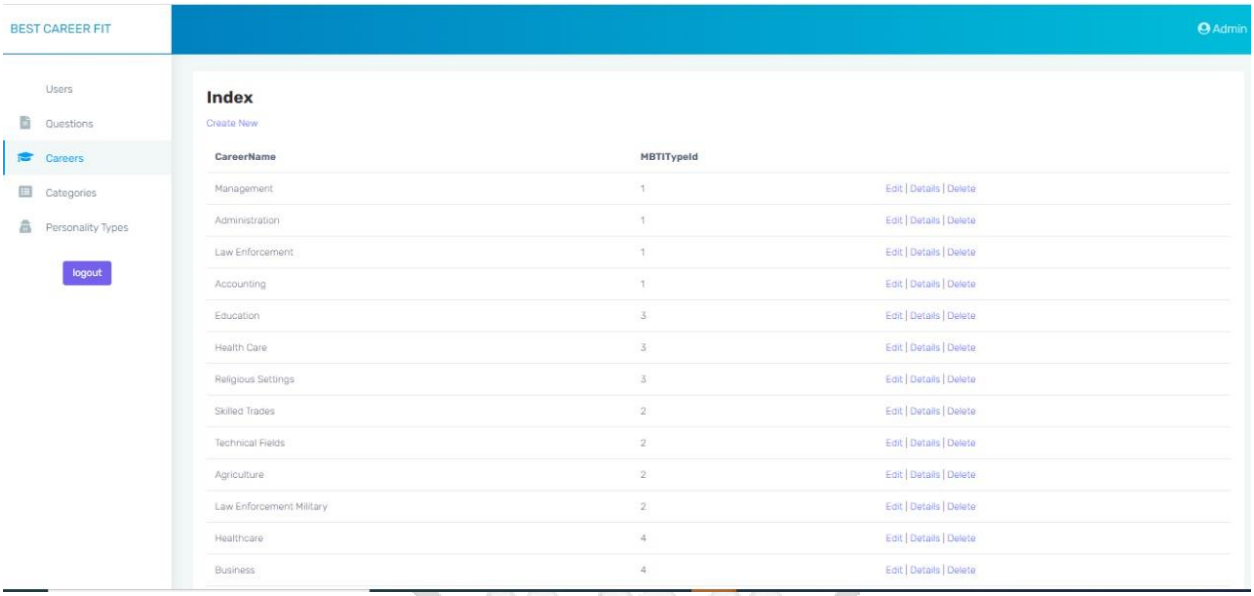

Figure 5.10: View Careers page

5.2.1.8 View personality Type page

The MBTI 16 personality types is a combination of traits bordering on Extroversion (E) and Introversion (I), Sensing(S) and Intuition(I), Thinking (T) – Feeling (F) and Judging (J) – Perceiving (P). From these four classification of traits, a combination of the dominant traits from each class combination when combined together bring about the 16 personality types as shown on Figure 5.12 From this page in Figure 5.11, an administrator is able to modify the trait combinations.

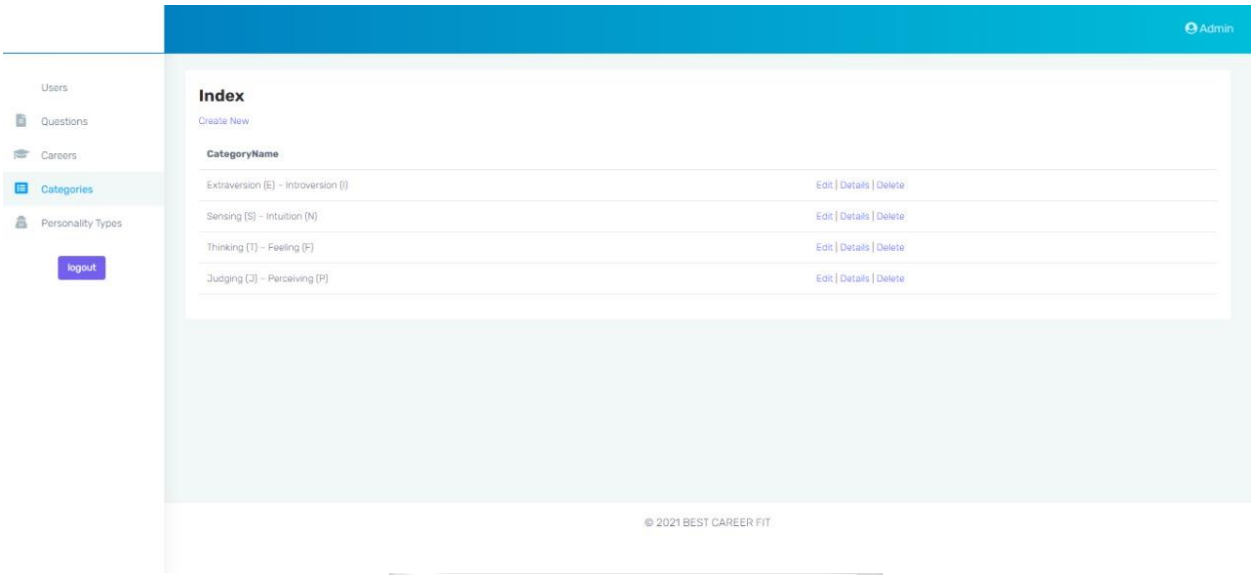

Figure 5.11: View personality page

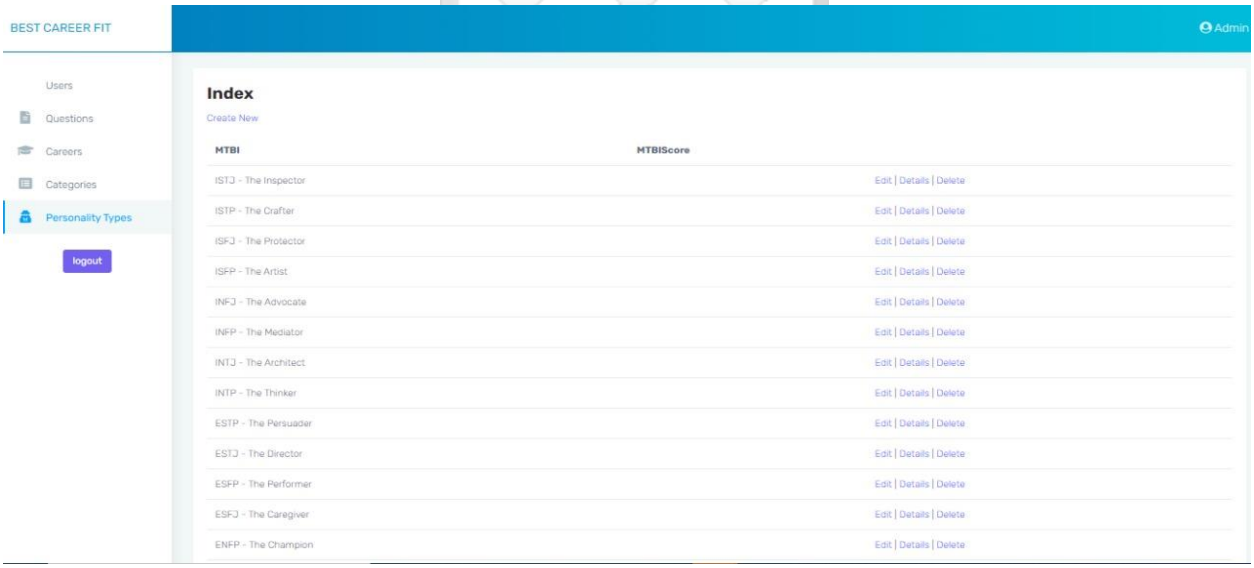

Figure 5.12: Personality Type page

5.3 System Testing

System testing was done to ascertain whether the system meets all the functional and non-functional requirements.

5.3.1 Functional Testing

Functional testing checks if application functions are working as per the established system requirements. The testing is applied on varied use cases with the aim of ascertaining if the performance is as expected. The test cases are indicated in Table 5.2 to Table 5.6

Login/logout test case

Table 5.1: Login/logout test case

identifier	**1**
Test case	Login/logout of the application
Description	User is able to access the system using his/her password and username
Utilized use case	Login/logout
results	Successful login/logout and access is granted to user
Pass/fail	**pass**

Table 5.2: take personality test case

identifier	**2**
Test case	Take personality test
Description	User can access the personality questions and answer them
Utilized use case	Take personality test
results	User can successfully take the personality test and know his personality type
Pass/fail	**pass**

Table 5.3: Suggest personality test case

identifier	**3**
Test case	Suggest personality
Description	System is able to display user personality on screen

Utilized use case	View personality test
results	User can view their personality type
Pass/fail	**pass**

Table 5.4: View Career Recommendation Test case

identifier	**4**
Test case	View individual career recommendations
Description	User can view list of career possibilities
Utilized use case	View career recommendation
results	After completing the personality test, a user is able to view the list of careers that best fit his personality
Pass/fail	**pass**

Table 5.5: recommend areas of improvement test case

identifier	**5**
Test case	Recommend areas of improvement
Description	System can advise user on areas they can work on so as to build on their personality
Utilized use case	View career recommendation
results	On recommendation page, user is advised on the areas they can work on based on their personality
Pass/Fail	pass

Table 5.6: share Recommendation test case

identifier	**6**
Test case	Share recommendation report
Description	User can receive their recommendation report on email
Utilized use case	Receive reports
results	The system should be able to send recommendation report to user if the user wants to receive it on their email
Pass/fail	pass

5.3.2 Non-Functional Testing

The researcher presented the developed system to the respondents in a bid to get their feedback on the developed application. Such feedback is important in determining whether the non-functional requirements have been met as well as whether the respondents find the system beneficial to them. Offline and online questionnaire were administered to the respondents so as to get their feedback on usability, acceptability, functionality and the feel and look of the system. The offline responses were fed into google forms and combined with the online responses and the results are as shown in Figure 5.10 to Figure 5.15.

i. Friendly Usability

Potential users who used the system were asked to give their feedback on how easy they found the system. 75% found the system easy to use while the rest found the usability to be average. The analysis is shown in Figure 5.10

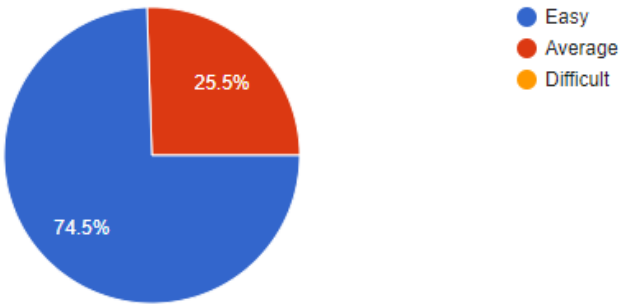

Figure 5.10: Ease of usability test case

ii. Functionality

to establish whether the system met the user requirements in terms of what the users anticipated to get from the system, the researcher asked the respondents to indicate whether they were able to login and logoff the system, take personality test, receive career recommendations based on their personality as well as receive recommendation report on their emails after request. The results are as shown in Figure 5.11.

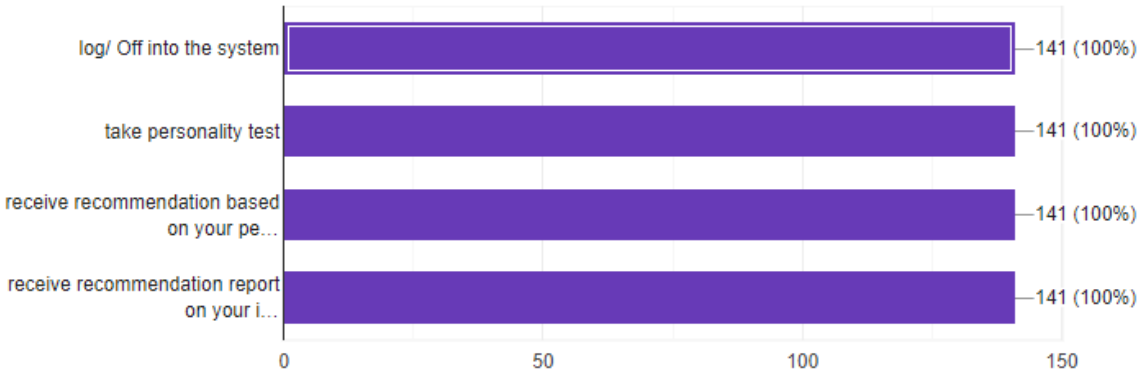

Figure 5.11: Response on system functionality

From the graph it is evident that the system met all the user requirements.

iii. Acceptability

The researcher sought to know whether respondents after accessing the system would accept to use the system as a career guidance tool, Figure 5.12 below shows that all the respondents agree to use such a system if presented with the opportunity.

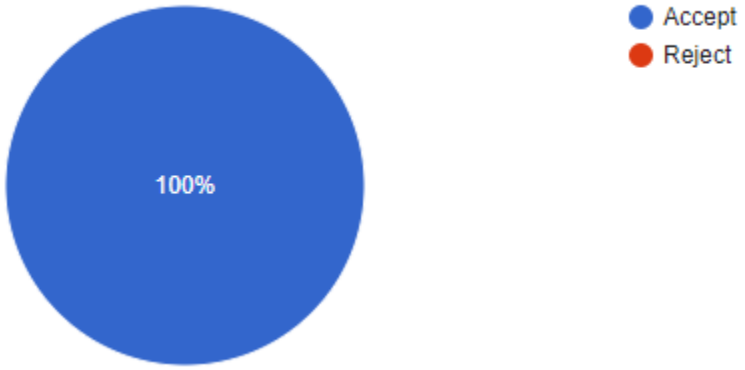

Figure 5.12: System Acceptability by respondents

iv. Application Design

A website needs to be attractive to the users. Respondents were asked to rate the system in terms of how they found its look and feel. 76.6% found the look and feel attractive, 22% were neutral while the remaining 2% found it unattractive. Figure 5. 13 shows the results.

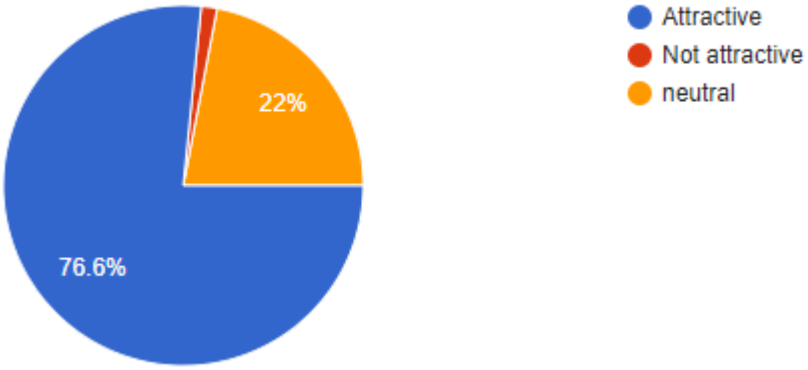

Figure 5.13: User Interface test case

v. System Evaluation

This test sought to know whether the system could be feasible as a tool for career guidance. When potential users were asked whether they would use the system for career guidance and the response

is indicated in the figure 5.14. Of the total study population, 75.2% of the found the system a feasible tool for career guidance while 22.7% were undecided.

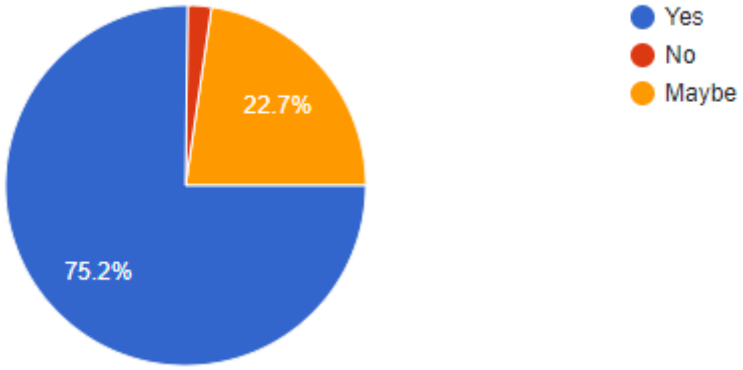

Figure 5.14: System Evaluation test case

vi. System Validity and reliability

The researcher randomly eleven respondents who had earlier on filled the user testing questionnaire. He requested them to retake the test again and compare the results of recommendation on first attempt and second attempt. The results are as in the table 5.7.

Table 5.7: Reliability test

Respondent No.	Personality 1st Attempt	Personality 2nd Attempt
1.	ISTJ - The Inspector	ISTJ - The Inspector
2.	INTP_The Thinker	INTP_The Thinker
3.	INTJ_ The Architect	INTJ _The Architect
4.	INTP_ The Thinker	INTP_The Thinker
5.	INFP_ The Mediator	INFP_ The Mediator
6.	INTJ_ The Architect	INTJ _The Architect
7.	ESFJ_The Caregiver	ESFJ_The Caregiver

8.	ESFJ_The Caregiver	ESFJ _The Caregiver
9.	ESFP_The Director	ESFP_The Director
10.	ESFP_The Director	ESFP_The Director
11.	ESTP_The Persuader	ESTP_The Persuader

From the table, it is evident that the system can be relied on after subjecting it to test-retest kind of reliability.

To decide whether the system was valid, the eleven respondents were asked if the personality type suggested by the system described them, the results are as in figure 5.15.

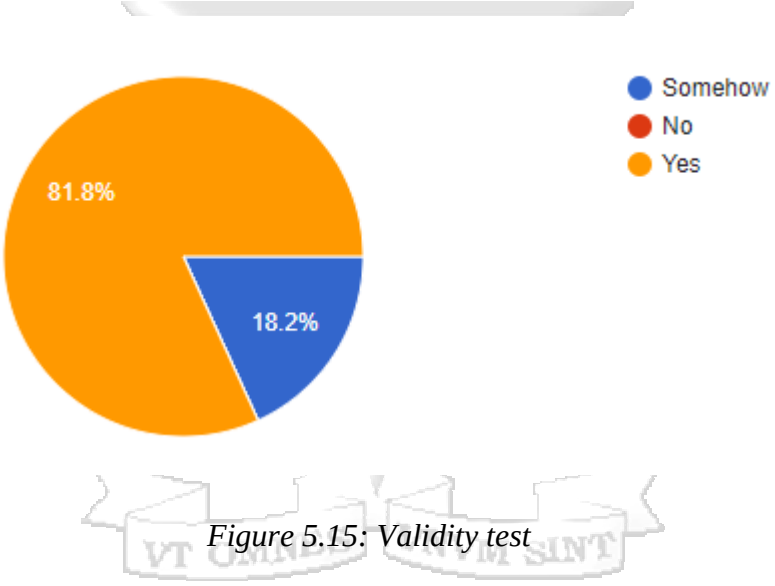

Figure 5.15: Validity test

From the chart,82% of the respondents said that the system truly described them while 18% were somehow convinced its them who were being described. It is therefore evident that the system passed the face validity test.

5.3.3 **Web Browser Compatibility**

To ensure cross platform functionality, the researcher tested the system on several web browsers and the results were as indicated in the table 5.8

Table5.8: Table of Browser Compatibility

Browser Name	**Compatibility status**

		yes	No
1.	Firefox	✓	
2.	Google Chrome	✓	
3.	Internet Explorer	✓	
4.	Safari	✓	
5.	Opera Mini	✓	

5.4 Summary

This chapter aimed to implement and test the developed system. The researcher purposed to develop a career recommendation system based on user personality. To achieve this, the requirements arrived at during requirement analysis phase were used for system implementation. Testing was done to check whether the system met all the identified requirements both functional and non-functional. The test results revealed that the system met all the identified requirements.

Chapter 6: Discussions

6.1 Introduction

In carrying out this study, the researcher aimed to come up with a solution that could make the process of decision making while choosing a career path to pursue simple and more straight forward. After analysing the challenges that individuals face in choosing a career, the researcher realised that there is a proven relationship between one's personality and career success hence the eventual development of a system that could suggest the best career fit for a user based on their personality. After collecting data from high school students and persons deliberating to change careers, doing a background research on related literature and carefully analysing the results, the researcher was able to come up with the anticipated solution. This chapter looks into the study findings, while giving their interpretations from which the researcher will be able to draw recommendations and conclusions

6.2 Summary of Key Findings

The picture that emerges from the analysis of data collected through the questionnaire and interview is one of immense challenges existing among individuals which is intrinsic to choosing a vocation where one can thrive in. The researcher established a relationship between one's personality and career success in the workplace. What is striking is that the respondents have little knowledge when it comes to the concept of personality and how it can impact their future career. However, 100% of the respondents agreed that they would gladly use a career recommendation system to help them in decision making.

The findings of this study agree with the theory of work adjustment as propagated by Dawis & Lofquist (1984) and John Hollands theory of human congruency with work environment as advanced by Brown, Lent, & Robert (2005). These theories agree that workers will thrive better in work environments where their personality best fits. Interviewees agree that personality has a direct link to how employees or even entrepreneurs perform while in the work place. High school students and those deliberating on changing careers agree that personality will impact their future career hence 99.7 % and 100% of them respectively are interested in knowing their specific personality and how it can impact their future career.

With the advancement of technology, the researcher found out that 94.1% of high school students had never used any career recommendation system because they don't know any that exists. The remaining 5.9 % had used a manual system in determining probable career paths. &9.2% of those deliberating to change careers had never used any while the remaining 20.8% could not remember the system they had used.

On further investigation, the respondents indicated that they would like a system that could allow them to securely log into it, take a personality test, let them know their personality then recommend a career and lastly send a report to their emails. These were the basis of the system that the researcher developed. After developing, the system was tested and it was found to be reliable in that it could produce similar results on second attempt while 81.8% found the system very valid in describing them as per the personality prediction.

6.3 Interpretation of Findings

While deliberating individuals face all manner of challenges while trying to make a career choice, a career recommendation system based on their personality can help make the process manageable even with a little knowledge. This can be attributed to the fact that there is a proven association between personality and career success.

This study found out, from the respondents, that the right personality will determine if they can endure career challenges, their performance while disseminating their duties, influences their passion and hard work in career of choice while assisting in interpersonal skills. This discovery is in agreement with historical literature that pin points that fundamental career decisions like choice of occupation, job satisfaction and performance, early occupational socialization, job tenure and turnover are affected by personality (Boudreau, Boswell, & Judge, 2016). This means that personality influences interests, attitudes and values, aspirations, maturity and decision making process during career choice-related process.

In previous literature, career assessment models use either one's interest as determining factor in finding relatable vocational match (Savickas,1993), interest and values inventories, ability and skills assessment (West White, 2015) or decision theory (Gati& Tal, 2008). These models bring about a manual mode of career path assessment. In this study, the researcher combined all these factors to come up with a recommendation system. The MBTI test which a user

takes consists of questions that touch on individual's interest, values, abilities, skills and mode of making decision which when sincerely answered the predicted personality becomes the basis of recommending a career.

Studies done by Yata et al (2018), Tandera, Hendro, Suhartono, Wongso, & Prasetio (2017), Kumar et al (2017) led to the development of personality prediction system. Their systems are only able to predict personality with no practical application module. To build on their studies, this study sought to come up with a career recommendation module which serves as an expansion on the applicability of automated personality classification.

Taken together, the study findings imply that with the automation of personality prediction and classifying the different careers into clusters that have been broken down (Table 2.2), career-decision making process will be less costly in terms of time and effort. This is because the many alternatives have been broken down into manageable clusters hence the choices are manageable. The recommendation system is again able to tell an individual what their personality is, their strengths and weaknesses while advising them on what they can do to improve themselves.

6.4 Relevance of Study to Research Objectives

To achieve the aim of this research which was to come up with a career recommendation system, the researcher administered two types of questionnaires. One before developing the system, for requirement gathering and ascertaining the feasibility of the proposed solution, and another after developing the system to aid in testing the system. From the pre-questionnaire, 94.1% and 79.2% of high school students and those deliberating to change careers confessed to having never used any career recommendation system respectively. The acceptability of the solution by both high school students and deliberating individuals was 100% for both groups as per figure 5.6.

In order for the researcher to meet the study objectives as indicated in section 1.3, the researcher collected information from both primary and secondary sources in a bid to understand the challenges that individuals face during career- decision making process. The understanding helped the researcher to ascertain the existing problems in choosing a career from which a solution could be developed.

Since the aim of the study was to come up with a system that could recommend a career based on user personality, the second objective which sought to analyse the relationship between personality and career. The results of the analysis which confirmed that there is a relationship between personality and career success led us to the third and fourth objectives which sought to review the techniques that have been used in career assessment and to develop an automated personality classification system that can match given personality traits with a given vocation.

The researcher administered the questionnaire in Appendix B to both high school students and deliberating individuals. After analysing the responses, the researcher found out that the system was a feasible option in reducing the challenges that many face in choosing a career.

From the gathered user requirements, the researcher was able to come up with the best fit career system that suggests career fields to users based on their personality. Through the system, a user is able to know about their personality, the personality traits, the best career fields that the personality fits and even offers advice on the areas where one can improve on so as to thrive better in the workspace when the time comes.

Benefits of the career recommender system

i. A user is able to know their personality based on their personality traits hence able to pursue a career most likely to thrive in.
ii. Since the prediction and recommendation results are based on data already existing in a database, the system is able to give proper result.
iii. The system offers users advice on areas where they need to work on so that they can be better versions of themselves.
iv. The system with some modifications can be applied in many areas like product marketing and advertising to customers based on their personality.
v. The system is very easy to use and simple to understand.
vi. The system can be used by anyone as long as they got internet connection and understand English.
vii. The system is affordable since it can be freely accessed by anyone with internet connection.

viii. The system is accessible through devices of all sizes: - personal computers and mobile phones.

Limitation of the developed system

i. The system can't be accessed offline
ii. Only English users can access the system
iii. If the user is not sincere in answering the test questions hence entering the wrong user information, the predicted personality won't be true to him/her hence the wrong career recommendation.

6.5 Implications of the results

The complicated world of work make career paths to be unstable, multi-decisional and predictable (Mitchell, Levin, & Krumboltz, 1999) hence individuals looking into deciding on vocational path need empowerment towards becoming independent decision makers. Individual empowerment will mean that deliberating individuals build on their self-awareness and so will be able to choose a career that meets their interests, abilities, needs and skills Sheri(2015). Individual empowerment through the use of a recommendation system will draw persons from making career decisions based on training time before earning, professional prestige, remuneration, training skills or location (Mitchell, Levin, & Krumboltz, 1999).

Schwartz (2004) alludes to the fact that a large pool of career alternatives presents an overload of choices that calls for effort and expertise that deliberating individuals may not have. During requirement gathering, respondents suggested the creation of a system that can recommend a career to a user. This served as a functional requirement in the system that the researcher developed. For the system, career faculties have been grouped as per MBTI personality types. With the career classification, deliberating individuals are able to make good use of the career alternatives without necessarily having to carry out in-depth information gathering (Gati and Asher, 2001; Germeijs et al., 2012).

The study results build on existing evidence of congruency between personality and career success hence bringing about the applicability of automated personality prediction in making career-decision making process manageable. The advice on personality weaknesses, strengths and

career offered in accordance with the resultant personality forms a concrete basis in empowering deliberating individuals towards the journey of self-awareness hence becoming independent decision maker.

Chapter 7

7.1 Conclusions

From this study, the researcher found out that individuals' face numerous challenges during career decision-making process. From the literature review (see section 2.2.3), the researcher found out that deliberating persons find it hard to choose a given career path due to challenges like financial and psychological risks that are involved in pursuing a given career path, an overload of choices that require great effort that deliberating individuals may not have, lack of proper know how of one's capabilities and preferences and difficulty in collecting information relevant to a given occupation.

From the interview guide in Appendix A, the researcher gathered some of the career choice challenges to be that deliberating individuals lack of appropriate guidance on the many career alternatives, parents or people who have power over them tend to choose careers for them, majority lack the information on any career, financial constraints make some not to pursue their preferred career and some may lack the required qualifications to train in the career they best fit.

Several theories like theory of work environment and big five factors of personality framework relate career success to personality type. The theories point to the fact that that individuals tend to thrive in work places where they blend in well while influences vocational interests and career decisions. After carrying out the interview with parents, career masters and persons already in work place, (Appendix A), the researcher was able to establish that the interviewees closely agreed that persons whose personality fitted the jobs they were doing seemed to be satisfied with the job they did, performed optimally, were more likely to get promotions and hardly changed jobs because they were satisfied with what they were doing. These finding affirm to the fact that there is an existing relationship between personality and career success.

Career guidance tools are not readily available to persons who may have intentions to use them. This conclusion was arrived at after the fact that when the researcher sought to know whether the respondents have ever used any career recommendation system, it was found that 94.1% of the students have never used any career recommendation system because they don't know any. 79.2% of those deliberating careers had never used any career recommendation system and those who

said they have could not expressively state which one. From the findings, it is important to develop a simple personality based career recommender system that could offer guidance to deliberating individuals who face challenges in deciding on the best career to pursue.

From the study findings, it can be concluded that individuals do face daunting challenges when making career decisions. To help alleviate these challenges, basing career choice on personality can be a starting point. Consequently, career recommender systems like best fit career system can be used as a guide in career choice.

7.2 Limitations of the study

The generalizability of the results is limited by the sample size which was small as compared to the general population of individuals who may be facing a dilemma in their choice of a career. For instance, students were drawn from just one secondary school as opposed to the numerous secondary schools and tertiary institutions in the country. The second limitation of the study resulted from wrongly filled questionnaire whereby some respondents did not answer all the questions or gave irrelevant answers to the questions. This further affected the sample size hence the results.

Thirdly, the study has under estimated the role of cognitive skills like family background, peer influences, life- time earnings, and socioeconomic status as elements that persons put into consideration when making career decisions. This is because the study presumes that personality is the only factor that should be considered when making career decisions. There is also a possibility that gender can influence the choice of a career with men preferring some career paths as compared to women.

The test questions are a little bit personal hence requires a user to be as sincere as possible in answering them. In cases where the user offers false information, the system will recommend a career that may not be the best fit to the user. This means that the accuracy of the system is greatly influenced by the sincerity of the user.

Despite these limitations, the study results are still valid. This is because there is a positive relation between past literature on personality and career an aspect realised from the findings, as well as the system meets all the functional and non-functional requirements after testing. This means that all the research questions have been answered by the study.

7.3 Recommendations

i. The study used K- nearest Neighbour as the supervised learning algorithm in predicting user personality. To improve on the accuracy of recommendation advanced algorithms like Neural networks and deep learning can be used in future.

ii. To optimise the benefits to the users, the system can be scaled up by adding a module where individuals who are experts in a given field can register in the system. The system in its recommendation can then suggest industry experts with whom a user can connect with for further hands on guidance.

iii. The government needs to take the initiative and sensitise career counsellors and career masters in learning institutions on the availability and importance of resulting to use personality based career guidance tools while delivering their mandate.

iv. As a tool it can be used as a compulsory career guidance tool for students in high school to guide them on subject choices, those entering colleges to decide whether to retain the courses they have been admitted to.

v. Career counsellors should result to using personality based career recommendation tools while counselling individuals having challenges at work to help them know where they need help so that they can thrive better in the work place.

7.4 Future works

Best fit career system serves as a prototype that can be further improved in future. With continuous research and the ever evolving technology, more discoveries can be made to make the solution better. Some of the areas for future exploration are: -

i. Developing a mobile application version of the system

ii. Combining personality and career market trends as a basis for suggesting best career fit

iii. Adding up a module where by industry experts can register and connect and network with system users.

iv. An offline version of the system can be developed for those without internet connectivity.

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Appendices

Appendix A: <u>Interview Guide to parents, career masters and those already in the job market</u>

1. Do you think a career guidance program is important when selecting a career?
2. Do you ever meet young people deliberating on career choice consult you on the same?
3. Do you think there is a relationship between career choice and one's personality?
4. What factors would your advice one to consider while selecting a career?
5. What sort of challenges do you see among candidates when selecting a career path?
6. What is the greatest contributing factor to success in a certain career?
7. What options are there for those intending to select a career from which they can get assistance?
8. Do you think a web application can assist those deliberating on selecting a career make an informed decision?
9. What features would you suggest such an application should have?

Appendix B: Requirement gathering questionnaire

The purpose of this questionnaire is to establish student's interaction with the concept of career and career choice. The study is being carried out among high school students for academic purposes only. Student participation is entirely voluntary and all responses will remain anonymous.

Your participation in filling out this questionnaire will be highly appreciated.

1. What course would you be interested to pursue? _____
2. What factors did you consider in choosing the course above?
   Personal interest [ ]
   Prestige [ ]
   Academic performance [ ]
   Employability [ ]
   Personality [ ]
3. Have you heard about the concept of personality?
   Yes [ ] No [ ]
4. If yes, what do you think is the impact of personality to your future career?
   _____
5. Would you like to know about your personality and how it can impact your future career? Yes [ ] No [ ]
6. Have you used any career recommendation system?
   Yes [ ] No [ ]
7. If you haven't used any career recommendation system, why?
   a. I don't know any

b. Lack of time
c. Do not like the technology
d. Lack of confidence
e. Others: _____

8. If you have used such a system(s), which one? _____
9. Why did you use the system?
    a. Compulsory to use
    b. Easy to use
    c. Others: _____
10. What features of a career recommendation system would you like/ dislike?

		Like	dislike
vii.	Allow to login to the system	[ ]	[ ]
viii.	Allow take MBTI test	[ ]	[ ]
ix.	Suggest your personality	[ ]	[ ]
x.	Recommend relevant career	[ ]	[ ]
xi.	Recommend areas for improvement	[ ]	[ ]

11. Which do you prefer?
    - Use a nickname to prevent others to know who I am
    - Use my real name to let others know who I am

12. What do you prefer to access career system(s)?
    i. Desktop
    ii. Laptop
    iii. Tablet
    iv. Smartphone
    v. Others: _____
13. Would you be concerned about the following?

		Yes	No
i.	Friendly usability	[ ]	[ ]
ii.	Timely feedback	[ ]	[ ]
iii.	personality outcome	[ ]	[ ]
iv.	career recommendation	[ ]	[ ]
v.	Others: _____		

14 . To whom do you like to expose your test report?
    - Your parents
    - class teacher
    - Keep private

Appendix C: Similarity Checker

Curiginal

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