Decision Support System for Final Year Project Management

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***Abstract*— In a university system, the final year project is a synthesis of all the knowledge the students have acquired throughout the different years of their stay in the university. This knowledge must be used to solve a specific problem.**

Finding and selecting the appropriate project topic and supervisor to supervise the students, presently is in most cases very subjective. This paper presents a web based decision support system that automates efficiently the management of final year projects. The main contribution of the research is to recommend project supervisors and project topic based Naïve Bayes prediction.

The decision support framework is web based, developed using JSP (Java-Server Pages), which integrates machine-learning algorithms to allocate final year projects and supervisor.

The developed system has been able to provide a platform that maximizes the potentials of students and faculties particularly to solve industry and community related problems. This research has provided a platform to improve the quality of final year research project in the higher institutions of learning. It has also provided a rich platform for available project prototypes and help to eliminate the problems peculiar to lack of automation in final year project management and decision making.

***Index Terms*— Data Mining, Classification algorithm, Naïve-Bayes algorithm, final year project management**

I. Introduction

A project is a unique venture with a beginning and an end, conducted by people to meet established goals within parameters of cost, schedule and quality. A project is a set of people and other resources temporarily assembled to reach a specified objective, normally with a fixed budget and with a fixed time period. Projects are generally associated with products or procedures that are being done for the first time or with known procedures that are being altered (Buchanan and Boddy, 1992).

In higher learning institutions, a final year project is mandatory as a requirement for every student to obtain a BSc Degree. This project might be individual based, and each student is required to choose a final year project topic based on her interest or it might be a group project. Every student is assigned a supervisor, who is familiar with the project area. For any selected project topic, students are expected to apply the theories and skills that have been acquired during their course of study.

Furthermore, after every student is assigned a project topic and a supervisor, they are required to submit a full report of their project topic alongside a presentation as a project defence. In computer science for example, these projects might be research based, automation of a process, or the combination of both. Sometimes, there is need for a prototype system, which would be required to test and ascertain theories that are discovered during the research process. Due to the importance of this process to obtaining a degree, there is need for project management decision makers to be able to make efficient decision regarding project allocation in order to provide innovative, ground breaking final year project that will have tangible effect in the society. Using traditional method of deductive reasoning and random selection of project topics without adequate resources and inference, has led to lack of efficiency presently experienced in project allocation as a result of having to factor in multiple conflicting objectives. These objectives include the interest of the students, the research interest of the supervisors, the grade and capabilities of the students and so on.

A study on Management Science reported that subjects who used DSSs made significantly more effective decisions than the subjects that did not have access to DSSs. Even though some scholars suggest that the human element is being overridden in the process of using a decision support system, thereby transferring decision making power to the computer, there is substantial empirical evidence on the improvements that information system has made in supporting the decision making loop (Bongani, 2013).

A variety of techniques have been developed to help decision makers solve problems with multiple objectives (Starrand Zeleny, 1977). Many complex problems are structured or semi-structured (Gorry and Morton 1971), and decision makers cannot define their problems or fully articulate their objectives when it comes to selecting a final year project. The decision making process adopted to solve semi-structured problems has often been perceived as unsatisfactory by decision makers (Densham and Rushton 1988).

A decision is basically resource allocation process that is irreversible except that a fresh decision may reverse it or it

Manuscript received July 1, 2017; revised July 23, 2017. This work was supported by Covenant University. I.T.

Afolabi, A. Adebiyi, E. G. Chukwurah and C .P. Igbokwe thanks Covenant University for their Sponsor and financial support towards the success of this publication.

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may overrule the earlier one (Alter, 1980). A decision is a reasoned choice among alternatives. The decision maker having authority over the resources being allocated makes a decision. The decision can be of various types like simple decision in which there is only one decision to be made with many alternatives, decision may be goal oriented; decision may be strategic or tactical (Finlay 1994). The decision capacity involves intelligence, design, choice and implementation of decision maker.

Decision support systems are computer-based program, which are designed in such a way to help users in problem solving or decision-making activities (Alavi and joachmsthaler 1992).

Decision Support System (DSS) play a great important role in order to ensure the confidentiality, greater transparency and healthy competition in evaluating final year projects.

This research describes a decision support system to manage final year projects efficiently and also act as supporting tool in assisting users by offering suggestions on final year topics and various research manuals and resources especially when complex problem is involved or encountered by the students.

II. LITERATURE REVIEW

Decision support systems have been used in several application areas, which include but not limited to the following;

In the health sector; Angelo et al, 2009 developed a *video decision support tool for advance care planning in dementia. They used* simple randomisation based on a computer generated scheme to assess the impact of a video choice backing instrument on the inclinations for future restorative consideration in more seasoned individuals in the event that they create propelled dementia. Tawadrous et al., 2011 performed a systematic review on the use of Clinical Decision Support Systems (CDSS) for Kidney-Related Drug Prescribing to discover that out of the 32 studies reviewed, 17 CDSSs were computerized and the rest were manual pharmacist-based systems. They concluded that CDSSs are available for many dimensions of kidney-related drug prescribing, and results are promising though there is need for additional high-quality evaluations to guide their optimal use. Other health related decision support systems include; decision support system design and implementation for outpatient prescribing (Andrianne et al., 2005); decision support systems for clinical management of depression (Yolanda et al, 2015).

In Environmental studies there are several decision support systems developed**;** *In 2015,* Garrido et al. selected *sewage sludge treatment alternatives in modern wastewater treatment plants (WWTP) using environmental decision support systems.* The methodology involved using NovEDAR_EDSS software combined with artificial intelligence techniques and different analytical tools such as Multicriteria Decision Analysis (MCDA) methodologies, LCA, Cost-Benefit Analysis (CBA) and Environmental-Benefit Analysis (EBA). This was used for the identification and assessment of the most appropriate sludge treatment technologies for the design of WWTPs. Albuquerque et al., 2013 developed a spatial decision support system for flood management which combines geographical information with wireless sensor networks.

Massei et al., 2014 developed a decision Support Systems for environmental management. In this research, Multi-Criteria Decision Analysis (MCDA) and Geographical Information System (GIS) was integrated a plurality of MCDA methodologies, grouped in a suite. The methods include ELECTRE I, Fuzzy set, REGIME analysis, Analytic Hierarchy Process and Dominance-based Rough Set Approach.

Other DSS project include but not limited to; Decision Support System for Portfolio Components Selection and Prioritizing (Hugo and Edie 2014); A knowledge-based Decision Support System for adaptive fingerprint identification that uses relevance feedback (Paul et al, 2015); Human Resource Management Decision Support System (Peter et al, 2004); Fuzzy decision support system for risk analysis in e-commerce development (Ngai and wat, 2005):

There are decision support systems existing in the field of project management, these include (OLTEANU, 2011), who developed a decision support system to identify opportunities for optimizing the value chain and lower the production cost of biodiesel. Also, (Sinem Besir and Kökten Ulas Birant, 2010) made a case for decision support systems on project management using neural network algorithm. Finally, in 2015, Izang et al., developed a Web-Based Decision Support System for Project Manager's Proficiency. Curve proficiency system was developed using Apache server, MySQL for the database with a combination of PHP, HTML, CSS, and JavaScript as the development tools.

Decision support systems has been used to improve final year project management, these include; Zhou et al., (1999) who assessed projects using fuzzy logic. Also there was a decision support system (DSS) developed to assist the supervisor and the panels during the process of final year project evaluation. The method involved Fuzzy Multi Criteria Decision Making (FMCDM) models and Weighted Model for decision analysis (Ghazali et al., 2013). Ahmad et al., 2012 developed a group decision support system used to achieve the objective of fair and accurate evaluation of final year project. It uses fuzzy ranked analytical hierarchical process and fuzzy TOPSIS. Our research is different from the above due to the reason that most of the decision support system in project management were used for evaluation and assessment of the project, but this paper aims to recommend project supervisors and project topic.

III. STATEMENT OF THE PROBLEM

In higher institutions of learning, every year, final year student is faced with the problem of access to existing related project and resources that would act as a prototype to ensure Project Success. Also there is difficulty in selecting an appropriate project topic, assigning of projects outside the students area of interest or capability and putting square peg in round hole as regards student- supervisor assignment.

IV. METHODOLODY

The methodology used in this research is based on the combination of the project management module and

ISBN: 978-988-14048-7-9
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

decision support module. The functional requirement implemented by the project management module includes; registration and login of students, update of student unique attribute, search for related project work, load projects and retrieve projects. Also, lecturers should be able to interact with students. Together with the above, the system should give anybody from the societal context, access to communicate with the institution and access existing projects so as to be able to see if it meets the need of their organization. For the decision support module, the system should predict, store or display the project topic and supervisor.

The system was implemented using Java Server page (netbeans IDE) on 1.33GHz CPU, 1024MB of System Memory and 250 GB of disk space.

A. *Decision Support Module*

The data gathered for the experiment was gotten from the final years students of Covenant University. A total of 300 students were used for the experiment and the following attributes were used for the prediction; CGPA (Cumulative Grade Point Average), results from the following courses (Software Engineering, File processing, Artificial intelligence and Project Management), Project Supervisor, Area of specialization of supervisor, area of interest of the student and the Project Topic.

The data gathered was divided into two. The first contained two thirds of the data, which was used to develop the classifier/model, and the remaining data set was used to test and evaluate the classifier model developed to ensure accuracy in the result.

The data was divided into two, two-thirds was used for the training and one-third was used for the prediction.

The algorithm implemented for the prediction is Naïve Bayes algorithm. Bayesian classifier is based on Bayes' theorem. Naive Bayesian classifiers assume that the effect of an attribute value on a given class is independent of the values of the other attributes. This assumption is known as conditional independence (Leung, 2016).

The naive Bayesian classifier works as follows:

1. Let T be a training set of samples, each with their class labels. There are k classes, $C_1, C_2, \ldots, C_k$. Each sample is represented by an n-dimensional vector, $X = \{x_1, x_2, \ldots, x_n\}$, depicting n measured values of the n attributes, $A_1, A_2, \ldots, A_n$, respectively.
2. Given a sample X, the classifier will predict that X belongs to the class having the highest a posteriori probability, conditioned on X. That is X is predicted to belong to the class C_i if and only if

$$P(C_i|X) > P(C_j|X) \text{ for } 1 \leq j \geq m, j \neq i.$$

Thus we find the class that maximizes $P(C_i|X)$. The class C_i for which $P(C_i|X)$ is maximized is called the maximum posteriori hypothesis. By Bayes' theorem

$$P(C_i|\mathbf{X}) = \frac{P(\mathbf{X}|C_i)\ P(C_i)}{P(\mathbf{X})}.$$

3. As P(X) is the same for all classes, only $P(X|C_i)P(C_i)$ need be maximized. If the class apriori probabilities, $P(C_i)$, are not known, then it is commonly assumed that the classes are
equally likely, that is, $P(C_1) = P(C_2) = \ldots = P(C_k)$, and we would therefore maximize $P(X|C_i)$. Otherwise we maximize $P(X|C_i)P(C_i)$. Note that the class a priori probabilities may be estimated by $P(C_i) = freq(C_i, T)/|T|$.
4. Given data sets with many attributes, it would be computationally expensive to compute $P(X|C_i)$. In order to reduce computation in evaluating $P(X|C_i)\ P(C_i)$, the naive assumption of class conditional independence is made. This presumes that the values of the attributes are conditionally independent of one another, given the class label of the sample. Mathematically this means that

$$P(\mathbf{X}|C_i) \approx \prod_{k=1}^{n} P(x_k|C_i).$$

In order to predict the class label of X, $P(X|C_i)P(C_i)$ is evaluated for each class C_i. The classifier predicts that the class label of X is C_i if and only if it is the class that maximizes $P(X|C_i)P(C_i)$ (Leung, 2016)

Figure 1.0 is the architectural overview of the decision support module.

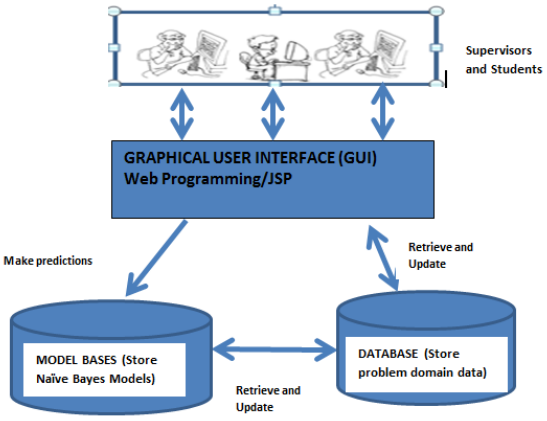

Figure 1 Overview of the DSS module

V. FINAL YEAR DECISION SUPPORT SYSTEM DESCRIPTION

Figure 2 is the screen shot of one of the interfaces in the DSS. This is the first page a user sees as soon as he or she logs into the system. It has four buttons that links to messages, search, upload and retrieval. The page provides the opportunity for users to send messages, search for available projects based on a specific search criteria and upload new project information.

ISBN: 978-988-14048-7-9
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

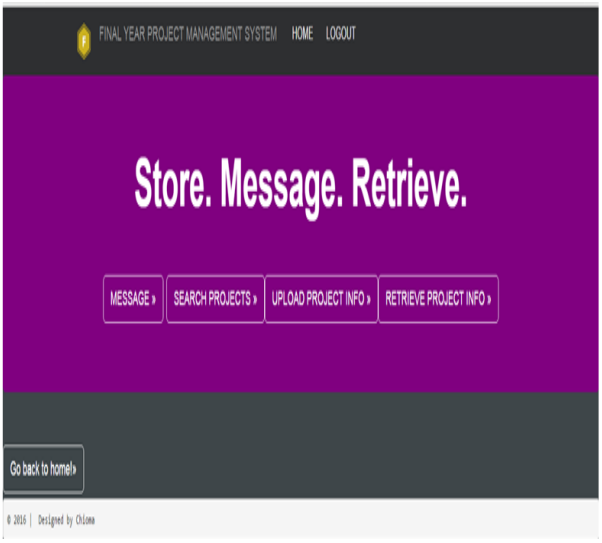

Figure 2: The first interface

Figure 3 is the interface to the decision support system module. It receives the details of the current student to be allocated. These include matriculation number, CGPA, and grades in software engineering, artificial intelligence, file processing and project management. At the click of submit data button, the system predicts the most appropriate topic and supervisors.

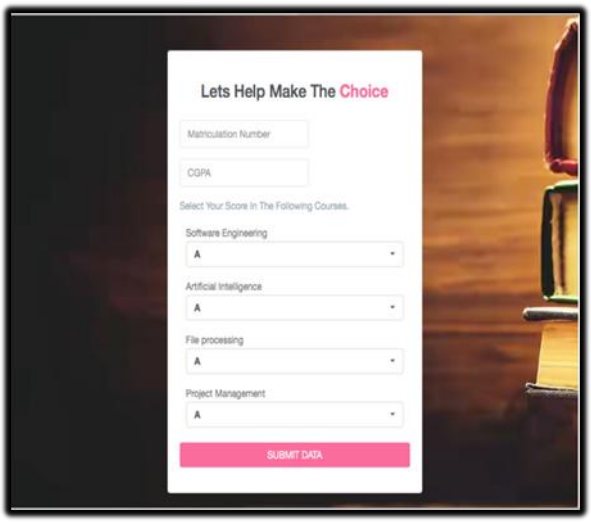

Figure 3 Interface to the DSS module

Finally, figure 4 is the prediction output page. The output page draws data from the inferences made by the machine-learning algorithm and displays it to the user. In this case, the data being predicted are the supervisor and project topic.

Figure 4: Prediction output.

VI. Conclusion and Further Study

Decision Support Systems (DSS) are gaining an increased popularity in various domains, including business, engineering, the military, medicine etc. They are especially valuable in situations in which the amount of available information is too large for the intuition of an unaided human decision maker- hence precision and optimality are of importance. Final Year Project (FYP) allocation is an important issue in technology-based program especially in Information Technology due to the fact that projects need provide innovative, ground breaking results that will have tangible effect in the society. This research has therefore, created a platform to improve the quality of final year research project in the higher education sector. The project management module will speed up the operations of the final year students' projects management in the institution and provide a rich platform for available project prototypes. In addition, it will help to eliminate the problems peculiar to lack of automation generally in final year project management by automating the decision making process, increase the speed at which projects are completed, help to Improve Student to Lecturer Interaction. The web-based DSS module will improve the process of allocation of students to supervisors and topic to students. This will ease the ambiguity which is associated with the traditional method of selecting a topic as well as to ensure optimality with the result produced, so the most appropriate project and supervisor is allocated the correct student at all times.

Further work that can improve the DSS is to add more functionality to the system, for example the ability to upgrade that stored project in case a prototype is improved upon. Also, the DSS can be improved by introducing semantic analysis into the process of prediction so as to improve the quality of the predicted outcome.

ISBN: 978-988-14048-7-9
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

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ISBN: 978-988-14048-7-9
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)