UniBud: A Virtual Academic Adviser

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***Abstract*—Academic advising is a challenging and time-consuming task. It requires well-trained dedicated professionals who give one-on-one consultations with students. While this approach is somewhat successful. In practice, advisers spend much time repeatedly answering questions that can be efficiently learned by an intelligent system. There have been several attempts to automate academic advising by means of expert systems and chatbots. However, functionality has been prioritized over usability. In response, we contribute, *UniBud*, a virtual academic adviser which is designed with usability principles in mind. UniBud uses DialogFlow, a natural language understanding platform, to build voice-based interactions with students. The interactions allow students to inquire about course information, enrollment, and other general enquiries. UniBud is not meant to replace traditional academic advising. Instead, it will support a limited set of academic enquiries that can relieve human academic advisers to assist students with more involving enquiries. We plan to test the usability of the system and collect feedback from potential users.**

Keywords—voice-based interaction, natural language processing, user experience

I. Introduction

Academic advising is essential to the success of students. Moreover, it can increase student loyalty [1] and prospective student recruitment [2]. Many universities heavily invest in training staff to assist students with different types of enquiries that help students explore and achieve academic, career, and life goals. In practice, however, advisers sometimes spend considerable time on answering repetitive questions that could be incorporated into an intelligent system. There have been numerous attempts to automate some aspects of academic advising by means of chatbots and expert systems. However, these systems and tools prioritize functionality over usability. In response, we propose, *UniBud*, a virtual academic adviser that uses DialogFlow [3], a natural language understanding platform, to build voice-based interactions with students. UniBud is designed to assist students with common academic issues such as course scheduling, enrollment and frequently asked questions. UniBud is designed with usability principles in mind. Further, it is flexible and trained to handle different types of expressions. UniBud is not designed to replace human advisors. For instance, it will not answer all students' enquiries nor will it assist in making critical decisions. Instead, UniBud escalates issues that it cannot handle to human academic advisers. We plan to assess the usability of the system and collect feedback from students and academics.

II. Literature Review

Approaches to automated academic advising fall into two categories: expert systems and chatbots. Hence, we divide the literature review into these two categories.

A. Expert Systems

Expert systems are computerized systems that emulate human decision making [4]. Many universities around the globe invested in expert systems that assist students in academic planning and course selection [5-9]. To cite an example, some of these systems provide recommendations for students based on prior academic performance [6] whereas others allow students to check graduation status [5] and handle complaints [9].

Unlike chatbots, expert systems can be hard to learn and inefficient for new students as they are mainly form based. Academic advising, however, has a conversational nature to it; allowing students to enquire about several issues in a variety of ways.

B. Chatbots

A chatbot is a piece of software that can carry a conversation with humans via textual or auditory approach [10]. Albert is one of the first chatbot-based virtual academic advisers [11]. The system uses natural language processing (NLP) to extract keywords and detect ambiguity. The system answers students' questions about scheduling and facilities. Further, the system provides recommendations that assist students in their course planning. Initially students were reluctant to use the system. The system was evaluated by college students and there were mixed responses. Some students welcomed the idea and reported that it was helpful whereas others were discouraged by some technical problems.

ESAElective is a chatbot designed to help students with elective course selection. It provides recommendations as well as sharing other students' experiences with courses [12]. The study concluded that a virtual academic adviser is a novelty that students welcome but cannot rely on yet. AdvisorBot [13] is another example of a chatbot that is integrated into a college database to support students with course enrollment, course prerequisites, and career path suggestions.

Some authors proposed an ontology-based chatbot to assist students with their academic enquiries. The chatbot aligns the enquiries with the correct database entities [14].

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All these attempts to develop chatbots that assist students with academic advising are promising. However, virtually none of the tools is fundamentally designed with user experience as well as usability principles in mind. We try to bridge that gap in our design of UniBud.

III. Design

In designing UniBud, we did not intend to replace existing tools and approaches to academic advising. Instead, we wanted to contribute a new interactive tool that can assist students with common enquiries anytime and anywhere; allowing human advisers to focus on advising that requires critical thinking, empathy, and creativity. Students can communicate with UniBud by talking or typing to it. Figure 1 shows the architecture of the system. UniBud uses a minimal database that keeps track of student, course, semester, and faculty information. UniBud is built on top of DialogFlow [3], a natural language understanding platform by Google. UniBud is accessible via a wide variety of platforms such as their phones, tablets, laptops, or virtual assistants such as Google Speaker [15]. Figure 2 shows the model of the database that we designed for UniBud. It is a simplified model of a university database. Departments offer courses. The Student table keeps track of student information such as ID, first name, last name, and major. Students may enroll in multiple sections. Instructors may teach multiple sections. A section is taught at a specific classroom at a certain weekly time.

We designed UniBud with these fundamental usability principles in mind: task efficiency, learnability, and subjective satisfaction. Without scoring high on usability, it would be hard to adopt UniBud by students.

We designed UniBud to assist students in answering specific and general questions related to their academic journey. We wanted to accommodate various types of questions students may have in mind. Furthermore, UniBud can contextualize the questions; giving different answers to the same question depending on the context such as time and location.

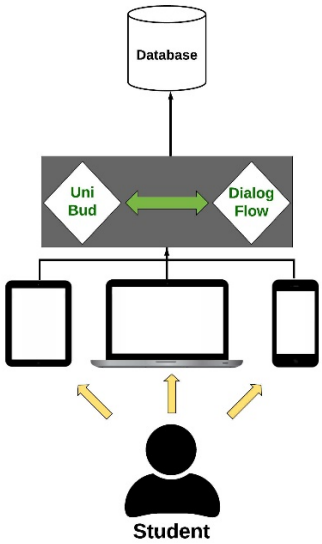

Fig. 1. UniBud Architecture Diagram

Identify applicable funding agency here. If none, delete this text box.

A. General and Individualized Enquiries

Students may have general or individualized enquiries. General enquiries do not require access to student information whereas answers to individualized questions rely upon the student asking the question. UniBud may consult with the database (Figure 2) of the system for individualized and general enquiries. As an example, to answer general questions related to instructors teaching a certain section, the system dispatches a join query that combines data from the Instructor, Semester, Section, and Course tables to obtain information (See algorithm 1). To answer an individualized question on the number of credit hours a student is currently enrolled in, UniBud searches the Student, Section, Course, and Semester tables for information.

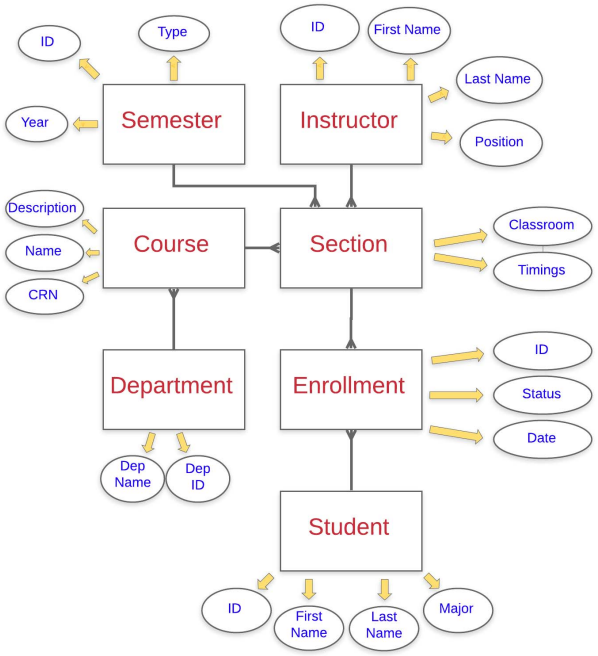

Fig. 2. UniBud Data Model

Algorithm 1: Find instructor for a given course

input: Given_Course_Number
output: A list of instructors and sections of that course.

1. Make the following SQL statements, and store the result in the variable result_set
2. SELECT Instructor.FirstName, Instructor.LastName, Section.Classroom, Section.Timings
3. FROM Course
4. INNER JOIN Section
5. INNER JOIN Instructor
6. INNER JOIN Semester
7. WHERE Course.CRN=Given_Course AND Semester.ID= <<Current Term>> AND Semester.Year= <<Current Year>>
8. **foreach** entry in result_set **do**:
9. convey to student instructor name and section information
10. **end**

B. *Intents*

UniBud is designed to assist students in obtaining a variety of information related to their academic life. When students interact with UniBud, they have a goal in mind such as getting information about a schedule or a location of a class. This goal is referred to as "intent" in chatbot design. Figure 3 shows some examples of intents supported by UniBud. When students talk or type a message, UniBud identifies the relevant intent. Each intent extracts data relevant to the question to be able to assist the student. UniBud has been trained with phrases associated with different intents. For example, Figure 4 shows different expressions that can trigger the Schedule Intent. The result of this interaction is extracting some data variables that UniBud uses to answer the student's questions.

When students are interacting with UniBud, some pieces of information such as the course name are required whereas others such as semester optional (Figure 4). If students skip required information, UniBud prompts them to give the required information. If students skip optional information, UniBud uses default values. For instance, for the semester, the default value is 'current semester'.

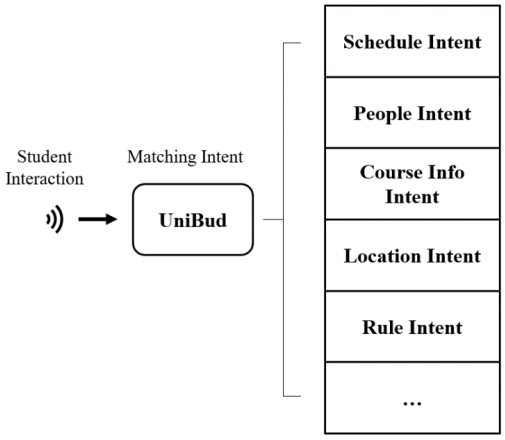

Fig. 3. UniBud Intent Matching

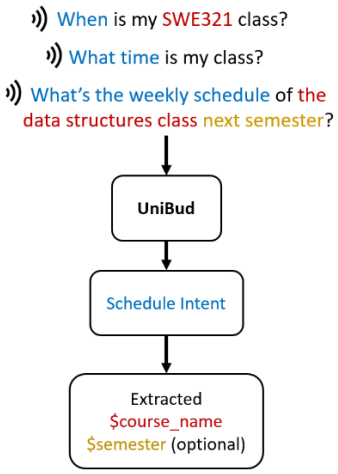

Fig. 4. Extracting data relevant to scheduling

C. *Wording Flexibility*

To create a system that scores high on learnability and task efficiency, we trained UniBud to accommodate different wording to accomplish tasks. Figure 5 shows several examples of how students can inquire about course prerequisites. Some expressions are short (e.g. the first and second phrases); accommodating task efficiency whereas other expressions suit detailed students and newbies (e.g. the sixth phrase); accommodating learnability.

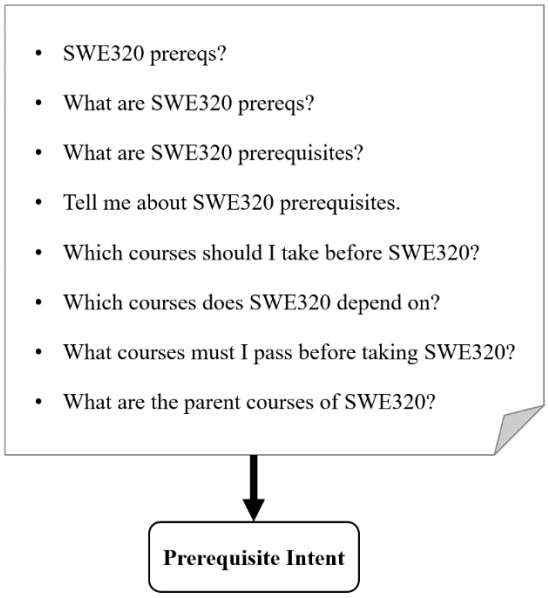

Fig. 5. Training Phrases for the Prerequisite Intent

To cite another example which supports learnability and task efficiency, UniBud allows for students to express their enquiries directly in a single sentence, or gradually with UniBud prompting students to elaborate on the inquiry. Figure 4 shows an example of UniBud interacting with two students. The first student (Amal) was not very specific with her request. As a result, UniBud asked her questions to be able to assist her better. The second student (Samir) was more specific. Hence, UniBud was able assist him directly.

- **Student (Amal):** I want to ask about course *enrollment*
- **UniBud:** Sure. Do you want to know about courses you should enroll in, or who teaches the courses, or the number of credit hours you can enroll?
- **Student (Amal):** Tell me about *what courses I can enroll in*.
- **UniBud:** You can enroll in SWE320, SWE371, and SWE346.
- **Student (Amal):** Thanks
- **UniBud:** You are welcome!

- **Student (Samir):** What courses can I enroll in the next semester?
- **UniBud:** You can enroll in SWE320, SWE371, and SWE346.

Fig. 6. UniBud accomodating specific requests, and requests needing further prompts

D. Context Awareness

One of the most important objectives of UniBud is to create a rich user experience. Hence, it is crucial to contextualize student enquiries. As an example, UniBud considers the date and time of the question. For instance, if a student asks about the location of a class, UniBud's answer will depend on the time of the question. To illustrate, if the student asks the question right before an upcoming class that is scheduled on the same date, UniBud mentions the location of this upcoming class. In a different context, UniBud will give a general answer about the classrooms of all classes the student is enrolled in (See Figure 7).

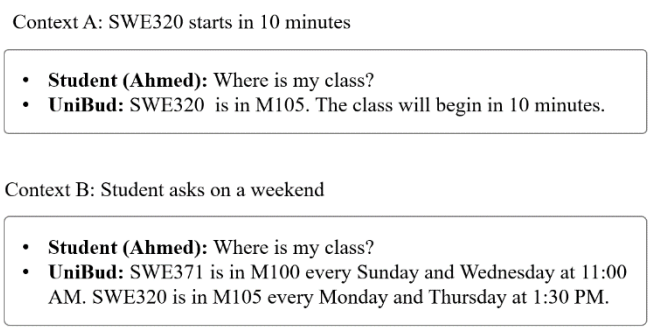

Fig. 7. UniBud Context Awareness

IV. Implementation And Evaluation

To ensure high usability with factors such as ease of learning, task efficiency, and subjective satisfaction, we plan to involve stakeholders such as students and academic advisers in the implementation phase of the system. We are planning to use the iterative model [16] as our process model. We will be learning about phrases that students mostly use for academic enquiries. Further, we will be identifying usability problems that need to be rectified. To evaluate the usability of the system, we are planning to conduct usability studies involving a variety of students from different departments and levels. To measure task efficiency, we will measure the time it takes students to carry out different tasks. If a task takes a longer time than we anticipated, we will assess that issue. To measure ease of learning, we will ask students who are new to the system to interact with it and record any usability problems they may face. To measure subjective satisfaction, we will conduct a survey at the end of each usability session and ask students about their personal experience with the system.

V. Conclusion And Future Work

In this paper, we proposed, UniBud, a virtual academic adviser which is designed with usability principles in mind. UniBud uses DialogFlow, a natural language understanding platform, to build voice-based interactions with students. The interactions allow students to make enquiries relevant to their academic life such course prerequisites, course schedule, etc. UniBud can accommodate a variety of expressions and phrases. Further, it gives answers relevant to the context of the question. UniBud is not meant to replace traditional academic advising. Instead, it will support a limited set of academic enquiries that can relieve human academic advisers to assist students with more demanding issues. In the future, we would like to explore incorporating forecasting algorithms and a recommender system akin to the second author's works in [17] and [18]. Such algorithms could be utilized to predict and recommend course paths and majors that allow students to flourish in their academic lives. Further, we are planning to conduct in-depth usability studies at a large scale.

References

[1] J. C. B. Vianden and, P. J. Barlow, "Strengthen the Bond: Relationships Between Academic Advising Quality and Undergraduate Student Loyalty," NACADA Journal, vol. 35, no. 2, pp. 15–27, 2015.

[2] K. M. Elliott and, M. A. Healy, "Key Factors Influencing Student Satisfaction Related to Recruitment and Retention," Journal of Marketing for Higher Education, vol. 10, no. 4, pp. 1–11, 2001.

[3] Google, "Dialogflow, natural language processing platform", found at: https://dialogflow.com, February, 2020.

[4] P. Jackson, Introduction To Expert Systems (3 ed.), Addison Wesley, p. 2, ISBN 978-0-201-87686-4, 1998.

[5] L. Keston and, W. Goodridge, "AdviseMe: An Intelligent Web-Based Application for Academic Advising," International Journal of Advanced Computer Science and Applications, vol. 6, no. 8, 2015.

[6] O. Daramola, O. Emebo, I. Afolabi, and, C. Ayo, "Implementation of an Intelligent Course Advisory Expert System," International Journal of Advanced Research in Artificial Intelligence, vol. 3, no. 5, 2014.

[7] G. C. B. Engin, B. Aksoyer, M. Avdagic, D. Bozanlı, U. Hanay, D. Maden and, G. Ertek, "Rule-based Expert Systems for Supporting University Students," Procedia Computer Science, vol. 31, pp. 22–31,2014.

[8] K. Hingorani and, N. Askari-Danesh, "Design and development of an academic advising system for improving retention and graduation".

[9] E. Afify and, M. Nasr, "A Proposed Model for a Web-Based Academic Advising System". International Journal of Advanced Networking and Applications, vol. 9, no. 2, pp. 3345-3361, 2017.

[10] IBM, "What is a Chatbot?", found at: https://www.ibm.com/cloud/learn/chatbots-explained, February 2020.

[11] E. M. Latorre-Navarro and, J. G. Harris, "An Intelligent Natural Language Conversational System for Academic Advising," InternationalJournal of Advanced Computer Science and Applications, vol. 6, no. 1,2015.

[12] C. H. Chan, H. L. Lee, W. K. Lo, A. Lui, "Developing a Chatbot for College Student Programme Advisement", International Symposium on Educational Technology, DOI: 10.1109/ISET.2018.00021, July, 2018.

[13] W. Nwankwo, "Interactive Advising with Bots: Improving Academic Excellence in Educational Establishments", American Journal of Operations Management and Information Systems. Vol. 3, No. 1, 2018, pp. 6-21. doi: 10.11648/j.ajomis.20180301.12, 2018.

[14] H. A. Santoso, N. A. Sri Winarsih, E. Mulyanto, G. W. Sarasati , S. E. Sukmana, S. Rustad, S. Rohman, A. Nugraha, F. Firdausillah "Dinus Intelligent Assistance (DINA) Chatbot for University Admission Services", 2018 International Seminar on Application for Technology of Information and Communication (iSemantic), DOI: 10.1109/ISEMANTIC.2018.8549797 , September 2018.

[15] Google, "Google Home Assistant", found at: https://assistant.google.com/platforms/speakers/, February 2020.

[16] A. Cockburn, "Using Both Incremental and Iterative Development", STSC CrossTalk. USAF Software Technology Support Center. 21 (5): 27–30. ISSN 2160-1593, May 2008.

[17] M. A. Kuhail, B. Ahmed, C. Rottinghaus, "Smart Resident: A Personalized Transportation Guidance System", 2018 IEEE 5th International Congress on Information Science and Technology (CiSt), Pages 547-551, 2018.

[18] M. A. Kuhail, N. S. S. Gurram, "TaskDo: A Daily Task Recommender System", IEEE 2019 International Conference on Computational Intelligence in Data Science (ICCIDS).