Advice: Literature Review

Website Functionality & Implementation

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ABSTRACT

Student advisors are academics in the university who take on the extra role of being advisors to students on their academic careers. They are however often overworked and there is a need for a system to relieve some of the work they perform. We observe that the introduction of a platform that provides a student advisor in virtual form has promise to greatly improve the state of the quality of advice students are given. Students will approach our platform as their first port of call with the hope that most queries will be handled by the system, reducing the number of cases that require student advisors. In cases where one is still needed, the student advisors themselves will also be able to access the platform to gain a first report from the system before giving their advice. This work would be unnecessary if university websites were well collated and organized sources of information, but our review shows that this is not the case. Thus the need is there for a centralised platform that presents all the information students need in an easy-to-use platform. This need will be addressed by our platform.

KEYWORDS

Students; student advisor; university; virtual communication; web development.

1. Introduction

The task of advising university students has never been an easy one as there is no one size fits all solution. This leads to every institution implementing their own system with varying degrees of success. One of the most common methods of offering advice is through having academics in the department who take the role of a student advisor (SA). This is over and above their commitments as an academic. These advisors then have slots in which students can book to seek out advice from them on various queries about their degree. This works to a certain extent in practice but there still is however, a big disconnect between advisors and students [11]

A way in which this can be tackled is by providing a platform which collates and synthesises information in an accessible manner. Whilst university websites usually have this information available, they often fail when it comes to clarity, usability, information clustering and the use of jargon [2]. This presents an opportunity for a centralised system that addresses these concerns amongst others in order to aid the process of offering advice to university students.

The purpose of this literature review is to look at the landscape of work that exists on the effectiveness of SAs. This will be done with a focus on virtual/online systems that were put in place to either replace or aid student advisors. Through this we will gain insights on how best to implement such systems in the hopes of making seeking out advise easier for university students. The review will take a look at the traditional method of offering advice, systems that have been put in place in some institutions as well as security and privacy concerns that come with said systems. This study will be specific to the University of Cape Town and its systems. The paper ends with some concluding remarks and some pointers to future work.

2. Current State of Offering Advice

At present the way consultations work is that there firstly exists a SA. A SA is an academic in a respective department. They often serve as lecturers, course convenors, researchers amongst other duties over and above being student advisors. The student then has to make an appointment with the SA. Once they agree on the time, the student travels (usually to the SA's office) to meet with them. The two will then proceed to liaise in trying to offer the student meaningful advice.

2.1 Problems

With that context established, it is trivial to identify a number of problems with this system. These problems can be broken down into two subcategories. Namely, problems with SAs as well as problems with students.

2.1.1 *Problems with SAs*

Firstly, there exists a scheduling issue. SAs usually have many other commitments. This leads to them rushing through their SA duties so they can return to other matters [11]. Another issue is that sometimes SAs can come across as not having an interest in helping the student. Krupp [11] mentions that an important factor in a productive meeting is connecting with the student on a deeper level than just coursework. This simply is not possible unless the SA

expresses interest in helping students as well as not rush through their SA duties.

2.1.2 *Problems with Students*

Students should, however, express equal if not greater interest in bettering themselves and improving their education [11], which is not always the case. SAs expect students to also come prepared to the meeting to ensure a productive use of both parties' time. Students also tend to have erratic schedules and are not always able to conform to the strict time constrained schedules of SAs.

2.1.3 *Moving Towards a Possible Solution*

Through this we can see that some work needs to be done for both SAs as well as students. Many of these problems stem from lack of information on both parts. SAs know where to find the information but find it tedious and students don't know where to find (all) the information [2]. University websites should be an easy source of accessing information at the user's convenience but given these findings, it is clear that they are failing at that.

3. Why University Websites are not Enough

University websites are a massive repository of information, especially for large institutions such as the University of Cape Town. Because of the vast amount of information there is to display, it becomes scattered and cumbersome to find. A study by Margolin et al [2] showed that in an experiment investigating website usability of three common college websites, participants encountered 77 usability problems. The majority of these problems related to either finding information or understanding information. It should also be noted that these three websites were selected on the basis of them being more informative than many of the other websites that were reviewed. This experience is not unique to this study, Majid et al [12, 13] found the university websites under review were lacking in terms of usability and accessibility.

The usability problems which are ever present on these websites creates a barrier for both SAs who are trying to point students to the right information related to their query as well as students who are trying to read up by themselves. We believe that having a centralized, easy-to-use hub of information would make the lives of both SAs and students considerably easier.

4. Proposed Solution

Our platform is not being developed in the hope of replacing SAs but rather aiding them. We envision that a student will use our platform as their first port of call. We hope that our platform will be sufficient for most students and a visit to a SA will not even be necessary. Where a visit to a SA is still necessary, the student can take the results from the platform to the SA, and they can use those results as the basis of offering their advice. In the case that a student approaches a SA without first approaching our platform, a SA will be able to enter the student's details into the platform and it will provide a recommendation which the SA can use as their basis for offering their advice.

Our platform will host information sourced from faculty handbooks. We also aim to be able to create a PDF reader that will automate the process of extracting the necessary information from faculty handbooks. The information will be stored in a database that we will host on the back-end (the part of the system responsible for managing and providing data to the client) of the platform. Users will be able to provide the platform with information about their degree and what kind of assistance they need. The system will then attempt to provide information tailored to each individual request. The platform will also provide a page where frequently asked questions are displayed. We also aim to implement a chatbot that users can converse with to convey their needs. This chatbot will then consult the database and provide the necessary feedback.

4.1 Existing Work

The proposed solution is a web-based platform that will be the go-to for sourcing all the information easily and quickly. Coates et al [3] implemented such a system in their study, although for them it was with a focus on the emergency medicine specialty for medicine students. From a survey they conducted, their program received 67% positive comments from students as well as 60% positive comments from mentors. Their system was regarded as a success and improved access to information for medical students. It was however not scalable as they did not anticipate the popularity of the program.

The idea of a virtual student advisor was even found to be successful in the high school environment through a study conducted by Gurantz et al [4]. They found that providing a virtual advisor increases enrollment in colleges with higher graduation rates. Carolis et al [6] took a more human-oriented approach by employing the use of a humanised animated agent (humanised character) which tries to emulate human-like responses via text. Their evaluation study showed promising results, but their system faced several implementation issues which stemmed from the tools and technologies they used for their implementation.

A popular technology that is used when it comes to human-computer interactions is artificial intelligence (AI). Of course, AI is a very broad topic and can be broken down into many subcategories. Suvethan et al [1] used Natural Language Processing (NLP) (one branch of AI) in their implementation of a virtual student advisor. Their system uses NLP to handle students' queries by tokenizing the sentences and extracting answers based on keywords and comparing synonyms.

This type of implementation works well with both textual input as well as aural input. These techniques can possibly be integrated into our system in order to aid returning relevant results to a search. This will also introduce the ability for users to enter queries in a more conversational way. For example, instead of searching "transferring faculty information", a user could say "I am looking for information on how I can go about transferring from Engineering to Science" and these two search terms would return the same result. In the latter case, the system would use NLP to extract out the tokens "transfer", "Engineering" and "Science" and determine that it should present the user with faculty transfer procedures.

An alternative to NLP is using a rule-based system. That is what Lodhi et al [10] did in their study in implementing an intelligent student assistant. This approach is suited for situations in which there does not exist a corpus of documented information. One benefit of this approach is that it uses an inference mechanism without fixing the set of queries. This means that the user is allowed to ask anything related to the domain without having to stick to the already framed list of questions in the database. Whilst this sounds like an appealing benefit it also comes with a drawback. Because there is no corpus of documented information with this technique, expert knowledge is required to design the system. With that said, because we do have documented information in the form of faculty handbooks and existing website data, we see no need for expert knowledge and thus no need for implementing a rule-based system.

4.2 Proposed Technology Stack

For the implementation of the website, we will be using popular cutting-edge technologies to both take advantage of an established community of developers as well as make use of the latest technologies that will benefit our platform. One technology that embodies this better than most others is React.js and that will be the technology of choice on the front-end (the part of the system responsible for the visuals and what the user interacts with). We chose to go with a JavaScript framework because it allows us to harness the power of the libraries [15] that can be used along with them as well allowing for reusing components and the ease of embedding logic in the layout of the website. We will specifically be using Next.js which is a React framework which provides all the same benefits as React with additional benefits such as built in TypeScript and Sass support as well as built-in support for routing and client-side/server-side rendering [19].

We will in fact be taking advantage of the built-in support for TypeScript and have a site-wide implementation using TypeScript. TypeScript is a superset of JavaScript that introduces static typing which Fischer et al [5] found to provide a positive impact on developer productivity in most cases. We will also be using Sass over regular CSS for many of the same reasons.

The back-end will be implemented using Node.js to once again take advantage of the well-established community and the libraries available. Some tasks that the back-end will handle will include handling the storing of the data, handling authentication and any other background services that will be run on the platform. For the storing of data, we will use MongoDB. We opted for a NoSQL database because we anticipate that a lot of the data we will have to deal with will be unstructured and presented in JSON format. NoSQL databases handle such data better than their SQL counterparts [20]. The back-end will be hosted within Next.js built-in API route system as this allows for much easier deployment on Vercel.

5. Security and Privacy Concerns

Our platform will be handling student data, so security and privacy are crucial to implement to ensure compliancy with all standards.

5.1 Security

Cyber-attacks are becoming more prevalent especially to agencies which hold large amounts of user data like our platform will. One security consideration is dealing with passwords crackers and harvesters of users' personal information [7]. Hosseini et al [7] conducted a study in which they investigated security in patient portals. Since they were dealing with medical information, it was of paramount importance that their security systems were of a high standard. They found that it is possible to detect web crawlers (a computer program that automatically searches documents on the Web) using Bayesian networks and take the necessary action to prevent access to data. It is also possible to identify crawlers through their navigational patterns as they do not follow the navigational patterns of humans [14].

The method of content delivery also affects the security of the platform as a whole. A common way of managing content is through the use of content management systems (CMS). Dadkhah et al [8] found that many journal websites put themselves in a vulnerable position by making use of old and vulnerable versions of CMSs. Expert attackers could bypass the CMS and inject malicious code and steal researchers' sensitive information. This is an important consideration as our platform will likely make use of a CMS to a certain extent.

Our platform will be implemented with both front-end and back-end technologies. Each of these present their own unique challenges as discussed by Ivanov et al [9] in their paper. Back-end technologies are susceptible to attacks in order to lock up computing resources, the implementation of denial of service or the disclosure of confidential data. Front-end technologies attacks on the other hand aim to compromise a user session, execute code in the user's browser or access the user's confidential data. In order to avoid these kinds of attacks, it is crucial to make use of best practices when working with both front-end and back-end technologies. Ivanov et al [9] recommend a tool called QtWebEngine which implements the processing of JavaScript scripts on the page amongst other solutions.

5.2 Privacy

Our platform will be a store of a vast amount of student and university information. This means that our platform will need to abide by and be compliant with all the necessary privacy regulations. The right to privacy is recognized as a fundamental human right in the Bill of Rights of the Constitution of the Republic of South Africa and is protected in terms of the Constitution and the common law. Although this has been established since 1996, South Africa only recently adopted a data protection legislation [16]. Alongside this there exists the Protection of Personal Information Act which we will also have to comply with.

One of the considerations is providing a relevant privacy policy [17] to ensure transparency and so that users are aware of how their data is being stored and processed. This privacy policy needs to comply with the aforementioned privacy and data protection laws. Moriarty [18] speaks of "Privacy by Design" which refers to privacy being a consideration from as early as the design stage of a website. Just as how responsiveness, accessibility and visual appeal are considerations, privacy should be too. This strategy ensures that privacy is not merely an afterthought that is slapped onto the platform towards the end of development but is integral and baked

into the design of it. This will be our approach in developing our platform.

Some implementation-specific details that will also be followed include making use of HTTPS-only communication. This ensures information is sent over secure networks only mitigating the risk of interception by attackers. Minimising or if possible, eradicating the use of tracking agents on our platform. Where tracking data is stored, it should be suitably anonymised to ensure it cannot be linked to users.

6. Discussion

From the existing work we have looked at, there exist systems in place which do bits and pieces of what we envision our system to be. However, we found that there does not exist a platform which consolidates all information and functionality that users would need. This presents an opportunity for our platform to fill that gap.

We found that there is little to no existing work in this domain that has been developed with Africa in mind. This is an even more unique gap that we have the opportunity to fill as the African landscape has unique challenges that other locations do not have to deal with. Some considerations include limited bandwidth and access to the Internet, language barriers and varying levels of literacy to name a few.

Internet access is not standardised in South Africa [21] and this has implications for the development of our system. It means we have to think about the sizes of the payloads our platform will be handling and transferring and have measures in place to optimise this. This is especially important to note since our platform will be dealing with potentially large amounts of data. Compression techniques will have to be employed to ensure that our platform is as bandwidth-savvy as possible.

South Africa has 11 official languages. Whilst English is the predominant language and the language of choice when platforms such as ours are implemented, many students struggle coming to grips with it. This problem is especially emphasised when convoluted language and jargon is used. This leaves students more confused than when they started looking for information and runs the risk of them making the wrong career decision over a language barrier. Thus as an additional feature, app translation will be looked into to have the platform serve as many students as possible in their native tongue.

There is also however, a variety of helpful information and work that has already been covered in this domain. A lot of the literature we looked at shows that the introduction of a virtual student assistant has showed improvements in the institutions they are introduced in. This is great promise for us as we plan our platform in this domain as well. We found that much of the existing work tends to be specific to a particular domain, such as Emergency Medicine. Our platform will however be very general and attempt to serve Science students firstly but also extend to the Commerce, Engineering and Humanities faculties as well.

With all this in mind, privacy and security is still a big concern and our platform has these considerations at the heart of the platform. We will be adopting privacy by design [18] and ensuring that our site is compliant with all security and privacy best practices. As per regulations [17], our privacy policy will also be available on the platform to ensure that users are aware of what data we collect, how it is stored and how they can go about deleting it from our systems should the need arise.

7. Conclusions

There is great value in students having a service that provides them with advice as they venture out into starting their careers [4]. The current systems are evidently lacking and failing students in some cases [2]. We believe introducing a virtual student advisor platform will mitigate and possibly even eradicate the problem.

In this literature review we looked specifically at implementing such a system at the University of Cape Town and the unique challenges that brings as an institution in South Africa. Our research has shown that there are several successful attempts that have been made in this domain but none that address our unique needs. We thus believe that our platform will provide value to both students and SAs who use the platform.

Extensions to this work could include expanding the platform to all the faculties offered at the University of Cape Town. Futhermore, other universities can be reached out to so they can join the platform and have their data accessible on the platform as well. We must however be careful to avoid bloating the platform.

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