

**Individual Essay**

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## Introduction

There is an increase in the need for healthcare services due to the fact that the population is growing every day hence increasing the number of patients who require these services from hospitals and other healthcare facilities. This significant increase in the number of patients who need healthcare services poses challenges to the staff working in these various healthcare facilities when it comes to handling their information through the use of manual systems. Information is very vital to any public service-provider organization, and its management matters a lot in determining the efficiency of service delivery to the intended population.

In the healthcare environment, patients need to conveniently book appointments to see their respective healthcare specialists. There have existed different booking mechanisms for placing patients' appointments; some of these mechanisms, such as telephone booking, have become tedious and inconvenient to both patients and medical staff due to the increasing number of patients in various healthcare facilities. The emergence of the internet has seen most of these appointment challenges mitigated through the use of automated online appointment and scheduling systems. The online appointment schedulers are usually web-based applications whereby patients can book appointments at their convenience using an internet-capable computer device. A good appointment and scheduling system will offer advantages to both patients and healthcare workers (Sanjana, 2019).

Although these online appointments schedulers come with a lot of benefits to both patients and medical staff, they also come with several downsides. Health records are very critical, and access to these records must be restricted to authorized persons. Online systems pose privacy and cybersecurity issues due to some people trying to manipulate these online systems to gain unauthorized access for different malicious intentions (Hoden, 2020). This report looks into the

benefits of using web-based appointment applications and different ways to address cybersecurity issues to ensure that the most secure online appointment and schedule system is in place.

### **Benefits of Appointment and Scheduling Management Information System**

- ✓ Time-saving – online booking saves time to both patients and medical staff; patients do not need to wait in line for other patients in case of telephone book since the online booking platform allows for multiple appointment booking at the same time. On the other hand, the medical staff uses less energy in managing the patients' appointments since most of the appointment management is taken care of by the system. Therefore medical staff can use the saved time to attend to more urgent and important tasks.
- ✓ Monetary savings - As a reduction in services and staff translates into a reduction in expenses, the facility's time savings can instantly transfer into monetary savings. The appointment management system can help reduce the demand for additional human resources required by the appointment scheduling process (Sanjana, 2019).
- ✓ Increases automation – online appointment schedulers do not require constant watch or management by the medical staff since these systems are built with the capability of doing a lot of work by themselves. Once the patient places an appointment, the system is able to use the provided data to tell the patient when their respective healthcare specialist will be available.
- ✓ Reduced scope of error – due to the fact that most of the processes in ASMIS (Appointment and Scheduling Management Information System) are automated, the required tasks are performed by the software with little or no human intervention with high levels of accuracy hence reducing the scope of error drastically. Humans are susceptible to errors, and

overloading medical staff with a huge number of appointments may cause exhaustion, leading to mistakes and inconvenience for the patients.

- ✓ Improved efficiency - Processes that are automated with the software will be taken care of mechanically without the need for human participation, resulting in immediate efficiency gains. The web-based appointment scheduler software follows a set of commands that can be executed forever hence avoiding human problems such as exhaustion and fatigue, lack of focus, or miscommunications; the software will execute accurately every assigned task every time.
- ✓ All-time convenience – in case of phone booking, medical staff are required to work around the clock if they want to deliver services to their patients all the time; otherwise, patients will be forced to book clinic appointments during the stipulated working hours. A patient can schedule an appointment at any time using an online appointment management system. More than 55 percent of all appointments are booked through online scheduling appointment systems after business hours, according to data (Sanjana, 2019).
- ✓ Increased data security – the use of a computer program to handle patients' data offers more security than physical files to keep the same records. Any person can reach these physical files and have unauthorized access to critical health records; this problem is solved by protecting computer software with username and password, allowing only the right people to access the patients' data.

### **Problems Associated with ASMIS**

There are some problems that come with online schedulers, including cybersecurity threats:

- ✓ Cybersecurity threats – this is the main problem associated with any sort of computerized system. Any web-based application is susceptible to hackers, especially unethical (black hat)

hackers who usually use advanced technology in the exploitation of weaknesses in a computer system with malicious intentions (Youngson, 2019). For ethical and legal reasons, patients' medical histories and other vital health data should be kept private. Despite the fact that security measures protect the healthcare system's network, network hacking is not uncommon. Cyber-attacks come in various ways, such as the use of malicious software (malware), phishing for critical information, denial-of-service attack, SQL injections, and password attacks.

Other challenges associated with online appointment schedulers include the following:

- ✓ Extra cost – a sophisticated and secure web-based application will not be acquired cheaply. Healthcare facilities handle critical health records, and therefore, they should acquire an information system using advanced technology that definitely will be expensive.
- ✓ Requires time to adapt – technology is always changing, and it requires someone with background computer literacy to adapt faster. This implies that it may take some time for both patients and medical staff to understand the system fully.

### **Clinic ASMIS UML Diagrams**

UML, an abbreviation for Unified Modelling Language, is a standard modeling language used in the specification, construction, visualization, and documentation of the software system's artifacts. This modeling language involves a set of integrated diagrams used to help software developers achieve the mentioned features of the UML. The best engineering practices that have been used in complex and large software systems for threat modeling purposes have been achieved through the use of the UML (Visualparadigm, 2021).

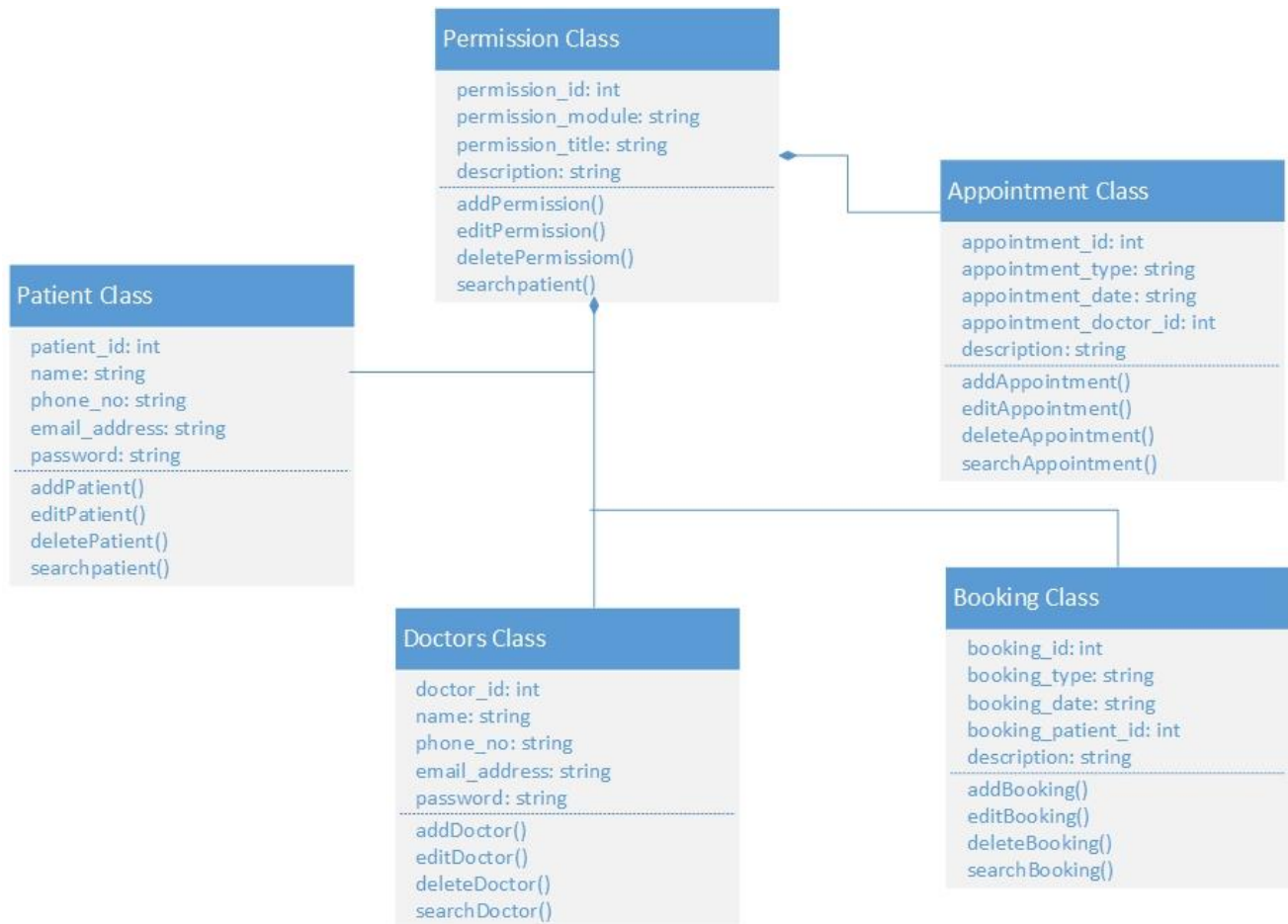
The UML is a critical component of object-oriented software development and the software development process. To express the design of software projects, the UML primarily employs graphical notations. Visual modeling by the use of the UML is very helpful to the development teams in communication, exploration of various designs, and validation of the software's architectural design. It comprises a set of standardized diagrams used to explain and communicate a software system's requirements, design, and code. It can be used to give several layers of abstraction for the system architecture and needs.

Therefore the use of UML in the modeling process is a crucial stage in the clinic appointment software development. This is due to the fact that a well-modeled software system will ensure that every phase and component of the software system, from requirements to implementation and testing, will be catered for. Good specification, visualization, and documentation are vital in ensuring a flawless end product, which otherwise could result in security vulnerabilities, giving malicious actors an easy chance to do what they like (Ouda, 2015). This section looks into various UML diagrams and how they can be used to mitigate potential cyber threats in the development of a clinic appointment and scheduling management information system.

## **1. Class Diagram**

The class diagram is one of the UML diagrams that is simply defined as the key building block of all software systems using objected-oriented architectures. The diagram is used to show various system classes, their attributes, and operations involved in each class; the class diagram also shows how each class relates to the other (Ambler, 2005). Through the use of a class diagram, the software can be modeled in a high-level abstraction without needing to look at the source code. In UML modeling, a class has three-part; class name at the top, attributes, and class operations at the bottom. The class diagram is very crucial in making sure that a software system

design is implemented with ultimate security considerations. The diagram below shows a class diagram used in the development of a clinic appointments system.



The diagram above has a total of five classes involved in the development of the clinic's appointment and scheduling software system. As shown in the diagram, security has been given the first priority through the Permission class. Every other class is linked to permission; the reason is to determine if an operation being performed at a particular class is authorized. Therefore, the modeling design above will not allow any unauthorized access to the system hence mitigating cyber-attacks.

## 2. Use Case

The key purpose of using a use case diagram in the UML modeling is to show how different users, normally known as actors, might interact with the software system. In simple terms, a use case diagram will summarize the different functionalities of the system and how different actors interact with these systems' functionalities (Ambler, 2005). The use case diagram allows the development team to relate what is required from the system to how the system delivers on those requirements.

Use case diagram has three key building blocks. The first one is the actor; this is an actor who interacts with the software system. An actor in a use case diagram can be an organization, an individual person, or another external system. Actors must be external since they only consume or produce data. The second use case component is the system; this is the whole scenario or the container having the functional requirements. It is simply the interface offering interaction between actors and the system functionalities. The last component is the goals, the results of the use cases. The diagram below shows a use case diagram of the clinic's appointment and scheduling management information system.





As shown in the diagram above, the system is represented by the rectangle. The outside figures represent the actors interacting with the system; doctor, patient, and system. The system actor is used to represent the automation capability of the software system. The oval figure inside the rectangle represents the goals or functionalities of the system. The actor doctor and the actor patient share three common goals; login and logout, update profile, and change password. The use case diagram shows the goals of each actor hence ensuring security.

## **Cybersecurity Technologies**

There are various technologies used to address cybersecurity threats; the following are some of the methods used to mitigate various cyber threats.

- ✓ Installation of anti-virus software – any computer used to access the ASMIS web-based application must be installed with reputable anti-virus software. Anti-virus software is used to prevent the system from malicious software hence preventing an attack from this cause.
- ✓ Use of firewall devices – a firewall device is used to protect the hospital network from any unauthorized access.
- ✓ Using up-to-date software – ensure that any utility software used in the computer is up-to-date; updates of this software should be done on a regular basis.
- ✓ Educating users to be wary of phishing information such as suspicious emails.

The key weakness associated with the above methods is the use of outdated utility software such as anti-virus. New updates always come with new security features, and using obsolete versions is risky due to its known security vulnerabilities.

## **Threat modelling Techniques**

Various threat modelling techniques can identify threats and mitigate potential cyber threats (Exabeam. 2021). Threat modelling can enable developers and engineers from Queens medical centre to identify threats and various ways that might be used to mitigate these threats (Exabeam. 2021). The security team at Queens medical clinic can assess the vulnerabilities and cyber threats posed by the new system. The modelling process of cyber threats involves five factors. These factors are threat mapping, threat intelligence, mitigation capabilities, risk assessment, mitigation

capabilities. These five vital processes provide different insights into threat modelling (Exabeam. 2021).

One threat modelling technique that may be used by Queens medical clinic might be the STRIDE threat modelling technique created by Microsoft engineers. It helps individuals identify and provide guidance towards the discovery of potential threats in a system. Queens medical clinic can use this threat modelling technique to establish potential threats and how to mitigate these cyber threats. The word STRIDE is an acronym that stands for S-spoofing, T-tampering, R-repudiation, I-information disclosure, D-denial of service and P-privilege escalation. These components of the acronym have various uses that help detect cyber threats (Exabeam. 2021).

UML and modelling engineers at Queens medical centre can use the STRIDE threat modelling technique because the technique is effective in identifying the causes and potential security threats that may be posed by the new web-based appointment and scheduling information system at Queens medical centre (Exabeam. 2021).

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