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Student declaration I certify that the assignment submission is entirely my own work and I fully understand the consequences of plagiarism. I understand that making a false declaration is a form of malpractice.			
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Grading grid

P1	P2	P3	M1	M2	D1

□ Summative Feedback:	□ Resubmission Feedback:	
Grade:	Assessor Signature:	Date:
Lecturer Signature:		

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I. Introduction

In this research paper my team will study the use of software development tools and techniques. My team then identify which tools and techniques have been selected for the development of this application.

II. Design tools

1. UML definition (P3)

UML, short for Unified Modeling Language, is a standardized modeling language consisting of a set of diagrams, developed to help systems and software developers define, visualize, and build. construct and document structures for software systems, as well as for business modeling and non-software systems.

My team choose draw.io to draw.

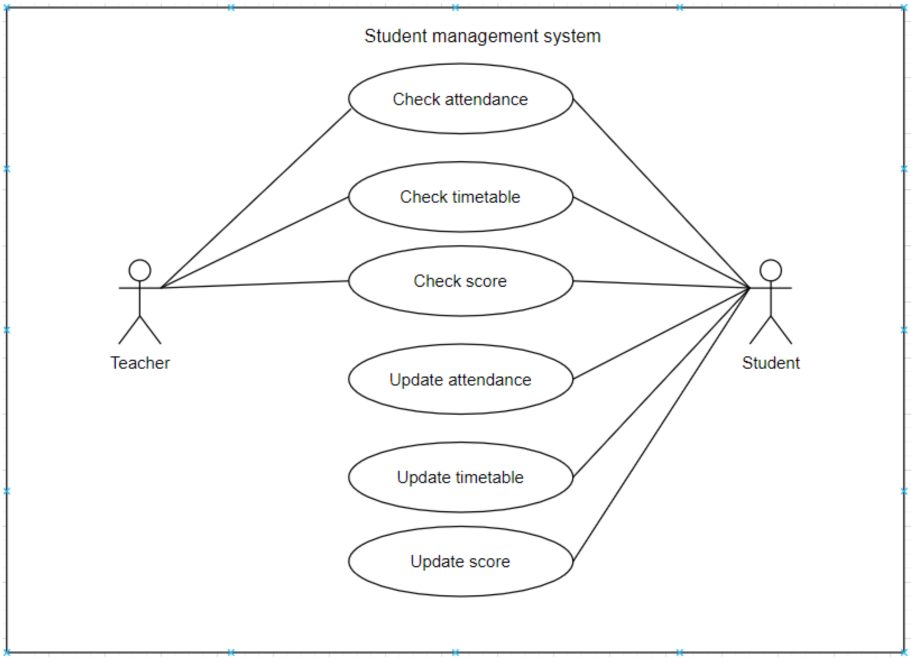

Figure 1:Example student management system

In the use case diagram above, there are two agents named student and teacher. There are a total of six use cases representing specific functions of the student management system. Each actor interacts with a specific use case. A student can check attendance, timetable, and checkpoints on either app or system. This agent is only able to perform these interactions with the system even though other use cases remain in the system.

The second agent is the teacher that can interact with all the functions of the system.

III. Development tools and techniques

1. Cloud provider

➢ **Amazon web server** : AWS benefits their users by providing a low-cost service, without any upfront costs. Amazon Web Service is easy to use, and users don't have to worry about servers, security, and databases.

Figure 2: Amazon web server

✓ Advantages:

- Easy to Use
- There is no storage limit
- Provides Speed and Agility
- Safe and reliable

✓ Disadvantages:

- Security limit
- High technical support fee:
    - ▪ Developer: $ 29 / month
    - ▪ Business: More than $ 100
    - ▪ Enterprise: Greater than $ 15,000 (AWS Advantages & Disadvantages | Advantages of Cloud Computing, n.d.)

- **Heroku**: Heroku is a cloud application platform - a new way to build and deploy web applications. Heroku allows application developers to spend 100% of their time on their application code, without server management, deployment, continuous operations, or scaling.

Figure 3: Heroku

✓ Advantages:

- Very low effort to run
- Easily extensible to add very powerful features, for example. I added memcache and caching to one of our apps and it worked within 30 minutes
- Less downtime stress (if it fails, you know heroku is addressing it and you have nothing to do but respond to the customer)
- Very few platform keys (unlike Google App Engine)
- Stand on the shoulders of giants
- Strong application segment = stable
- Easy pricing for customers

✓ Disadvantages:

- Can get expensive quickly :One of our job apps costs ~ $ 1000 a month
- The free tier can take up to 20 seconds to respond to a request (it turns the server down when it is no longer in use)

- Nothing much can be done if Heroku crashes (well, you mean having to have a backup server and use DNS to switch if that goes bad, but I can't imagine anyone bothering it. this)

➢ **Azure**: Microsoft Azure is Microsoft's official cloud service that is used to create, test, deploy, and manage services and applications across the globe through Microsoft data centers. These cloud services are intended to meet the needs of small and large businesses. They provide Software as a Service (SaaS), Platform as a Service (Paas), and Infrastructure as a Service (Iaas). Microsoft Azure is particularly flexible as it supports a wide variety of programming languages, frameworks, and tools from both Microsoft and third-party vendors.

Figure 4: Azure

✓ Advantages:

- Availability
- High security
- Reality: Azure can provide everything you need to grow.
- Scalable and cost-effective: It allows you to upgrade and remove services easily and pay only for what you use.

✓ Disadvantages:

- Management requirements for effective use: It does not support the management of cloud-based data centers
- Your location can affect the speed. (Pros & Cons Of Microsoft Azure, n.d.)

➢ **Google Cloud Platform :**as the name suggests, is a suite of cloud computing tools provided by Google. It is based on the same infrastructure as Google Search and YouTube, making it more accessible thanks to integration with end-user products and G Suite. This platform is dedicated to every type of business, from start-ups to businesses, but has been recognized as being chosen by young, innovative companies.

Figure 5: Google Cloud Platform

✓ Advantages:

- Good documentation. We are talking about hundreds of pages in total, including a fairly detailed API Reference tutorial
- Good price . Approximately $ 0.020 per GB / month for Regional tier and $ 0.007 per GB / month for Coldline tier
- Different storage classes for each need: Area (frequent use), Nearline (infrequent use) and Coldline (long term storage)
- Durable. Google Cloud Storage provides 99,999999999% (11 9's) of the durability of objects for a given year. This means that data persists even in the event of a loss of two disks simultaneously
- Various regions are available to store your data: North America, South America, Europe, Asia and Australia

- Easily integrate with other Google Cloud Services like Kubernetes Engine, App Engine, or Compute Engine
- The “Control Panel” tab in the documentation lets you try out the different SDKs for free. It is extremely useful for developers
- One of the best free classes in the industry. $ 300 free credits to get started with any GCP product for the first year. After that, 5 GB of storage is free to use forever

✓ Disadvantages:

- Support fee is quite high, about 150 USD per month for the most basic service (Silver tier)
- Downloading data from Google Cloud Storage is very expensive. $ 0.12 per GB
- Personally, I find the web interface of Google Cloud Platform a bit confusing. Sometimes I get lost while browsing through menus
- The SDK APIs appear to be less stable than the Amazon S3 APIs. I came across some examples in Stackoverflow that are no longer valid
- Prices in Microsoft Azure (about $ 0.018 per GB / month) or Backblaze B2 (about $ 0.005 per GB / month) are lower than Google Cloud Storage.
- It has a complex pricing scheme, similar to the AWS S3, so it's easy to get unwanted costs (number of requests, transfer ...) (Vidal, 2018)

My team choose heroku because Easily expandable to add very powerful features. It is in a strong and stable segment. It's easy to use and comes with free tier. It can connect to github so it's easy to update to github and run heroku.

2. Development languages

➢ **PHP** is one of the programming languages developed with built-in web development capabilities. Programmers can seamlessly embed code written in this popular server-side programming language into HTML code via the Script tag.

✓ Advantages:

- Speed up the development of custom web apps
- Simplify web application maintenance
- There is no need to write additional code

- Work with databases more efficiently
- Automate common web development tasks
- Protect websites from targeted security attacks: Built-in security features and mechanisms provided by the PHP framework make it easy for developers to protect websites from existing security threats. yes and emerging.
- Perform efficient unit testing
- No need to increase web development costs

✓ Disadvantages:

- Programmers need to learn PHP frameworks instead of PHP
- The quality of PHP frameworks varies
- Lacks options to modify core behavior
- Affects the speed and performance of the website (Solutions, 2018)

➢ **ASP.Net**, short for Active Server Pages.NET is a framework, developed by Microsoft and it serves the purpose of creating websites and web technologies.

✓ Advantages:

- Storage customization options: Developers can now customize things like user account data if they want more data associated with that particular user. The desired data can be added to the user interface implementation class. In addition, additional data can be stored by implementing IuserStore.
- High speed: The programming environment and language has many benefits that give developers the ability to grasp the basics quickly and create a website fairly quickly.
- Asynchronous Support: The vast majority of APIs in the framework are asynchronous and this can be considered an advantage. This is not only an obvious advantage now but also in the coming days.

✓ Disadvantages:

- Windows: Some developers dislike the fact that the ASP.NET framework tends to adhere to Windows forms.

- Poor Security Features - ASP.NET is known to lack some of the basic security features that other frameworks offer. Lack of email account verification, username prompt, mobile verification, password reset and modern password storage. (Szecsei, 2020)

➢ **Node.js** is just another server like Apache, IIS, TOM, etc. But unlike those servers, Node doesn't deal with PHP, .NET, or JAVA. It executes JavaScript on the server side. Yes, JavaScript doesn't have a browser; That is Node. Node itself is not entirely created in JavaScript; rather, its wrappers are made of C. It only executes JavaScript.

✓ Advantages:

- Asynchronous event-driven IO helps to handle concurrent requests.
- Using JavaScript, easy to learn.
- Share the same code with both the server and the client side.
- npm, the Node encapsulation module has become very large and is still evolving.
- Active and vibrant community, with lots of code shared via github, etc.
- You can stream large files.

✓ Disadvantages:

- Node.js does not provide extensibility. One CPU won't be enough; The platform does not provide scalability to take advantage of the many cores commonly found in today's server-grade hardware.
- Dealing with relational databases is a pain if you are using Node.
- Each use of a callback ends with tons of nested callbacks.
- Without digging deep into JavaScript if someone starts Node, he may have a concept problem.
- Node.js is not suitable for CPU intensive tasks. It's only suitable for I / O things (like web servers). (Shan, 2014)

➢ **Java** is the most widely used programming language and was designed for the distributed environment of the Internet.

✓ Advantages:

- Simple: Java is easier to use, write, compile, debug and learn than alternative programming languages

- Object oriented
- Platform-Independent: Java code runs on any machine without installing any special software, but the JVM does.
- Distributed computing: Distributed computing involves several computers on a network working together.
- Security: Java has no explicit pointers. In addition, it has a security manager that defines the permissions of classes.
- Memory allocation: In Java, memory is divided into two parts, the heap and the stack. Whenever we declare a variable JVM provides memory from the stack or the heap space.
- Multithreading: It has the potential for a program to perform multiple tasks at the same time.

✓ Disadvantages:

- Poor performance than other languages.
- Look and Feel: The default look and feel of GUI applications written in Java using the Swing toolkit is very different from native applications.
- Single paradigm language
- Memory management: Memory is managed through garbage collection, whenever the garbage collector runs, it affects the performance of the application. (Rogers, n.d.)

My team chose node.js because node.js is easy to learn and the community is vibrant. it has npm, the Node encapsulation module has become very large and is still evolving. Node.js is currently very hot in the market, so I want to try it out with node.js.

3. Database servers

➢ **MySQL** is the most popular open source database; chances are you ran through it once or twice on your developer's internet tour.

Figure 6: MySQL

✓ Advantages:

- There is more MySQL investment and innovation than ever: Oracle has increased its MySQL staff and provided it with a more complete engineering process where engineering and planning are driven from Oracle instead of spreaders. trash all over the world.
- The MySQL products remain solid.
- MySQL is designed with a focus on Web, Cloud, and Big Data.
- There are more MySQL projects than before: There are teams working on clustering software, manageability, database algorithm optimization, scalability, and scalability.

✓ Disadvantages:

- MySQL is not as mature as any other relational database management system: MySQL did not start out as an RDBMS (relational database management system).
- MySQL is open source: Under the umbrella of Oracle, MySQL now has proprietary, closed source modules.
- MySQL is owned by Oracle rather than community driven: Oracle does not accept patches or provide a public roadmap.
- Red Hat Enterprise Linux, Fedora, Slackware Linux, openSUSE and the Wikimedia Foundation have all switched to MariaDB, and MySQL has not. (Beatty, 2013)

➢ **MongoDB** is a document database with the scalability and flexibility you want with the querying and indexing you need.

Figure 7: MongoDB

✓ Advantages:

- Diagram: If you have a flexible schema, this is ideal for a document repository like MongoDB. This is difficult to do effectively in RDBMS
- Easily scale: Scale read using replica sets. Scales recording using sharding (automatic balance). Just boot up another machine and you'll be gone. More machines = more RAM to distribute your workstation.
- Price: Depends on which RDBMS of course, but MongoDB is free and can run on Linux, which is ideal for running on a cheaper suite.
- You can choose how much consistency you want depending on the value of the data (e.g. faster performance = enable and forget to insert into MongoDB, slower performance = wait until insertion is copied to buttons before going back)

✓ Disadvantages:

- The data size in MongoDB is usually higher due to example: each document has the field names stored
- Less flexibility with the query (e.g. without a JOIN)
- No transaction support - certain atomic operations are supported, at a single document level

- Current Map / Zoom (eg for aggregating / analyzing data) is OK, but not too fast. So if that is required, something like Hadoop might need to be added to the mix
- Little updates are available / fast-growing products (Pros and cons of MongoDB? [closed], n.d.)

➢ **SQLite** is a relational database management system similar to MySQL, PostgreSQL, Oracle or Microsoft SQL Server.

Figure 8: SQLite

✓ Advantages:

- There is no server, which means it's easy to set up and no configuration required
- The file-based system makes it very versatile
- Great for development and testing

✓ Disadvantages:

- Does not provide network access (ie access it from another machine) because it does not have a server
- Not built for large scale applications
- There is no user management (SQLite vs MySQL - Comparing 2 Popular Databases, 2018)

My team chose SQLite because it has no server, which means it's easy to set up and doesn't require any configuration. The computer's file-based system makes it very versatile. It is a great product for development and testing. It's free.

4. Software Models

- **Waterfall** is a linear sequential life cycle model. This means that it follows a simple structure of stages in which the outcome of each stage moves down to the next level of development. In other words, we don't look much at a large Niagara Falls, but rather a series of cascading waterfalls - each with its own small group of activities.

✓ Advantages:

- Everyone gets up to the pace quickly: Since technical documentation is a necessary part of the initial request phase, this means everyone understands the goals. New developers can get up to speed quickly - even in the maintenance phase.
- Time held: Development cycle according to each stage of discipline execution. Each step has a clearly defined starting point and conclusion, making it easy to track progress. This helps to reduce the "slippage" of any project compared to the agreed time period.
- No financial surprises: Costs can be estimated with a pretty high degree of accuracy once the requirements have been determined.
- Test done easily: The test scripts have been detailed in the functional specification of the requirements phase, which makes the testing process easier and more transparent.
- The result was clear: Even before the software development began, the design was detailed in order to make the needs and results visible to everyone.
- Addressing design problems: Potential development problems can be researched and addressed during the design phase - and planned alternatives - prior to any program execution. .
- What you plan is what you get: Many organizations appreciate the attention to the document from the start, as that also means there shouldn't be surprises with the end product.

✓ Disadvantages:

- It can be difficult to define needs: Customers may find it difficult to conceptualize their needs as a functional specification during the requirements phase. This means they can change their mind when they see the final product, which is difficult to solve if the application needs to be redesigned to a large extent.

- Lack of flexibility: There may be a problem with the flexibility of the model to accommodate new developments or changes in requirements that may occur after the initial consultation. Changes due to business plans or market influences may not be taken into account when all planning has been done in advance.
- Longer delivery times: Projects can take longer to deliver, compared to using an iterative methodology like Agile. (Kienitz, 2017)

➢ **V-Model**: One of the major flaws of the waterfall STLC model is the defects found at a very late stage of development since the test was done at the end of the development cycle. The repair of defects becomes very difficult and costly because it is found at a very late stage. To overcome this problem, a new development model was introduced called the "V Model".

✓ Advantages:

- Development and progress is very organized and systematic
- Works well for smaller to medium sized projects.
- Testing starts from beginning so ambiguities are identified from the beginning.
- Easy to manage as each phase has well defined Objectives and goals.

✓ Disadvantages:

- Not suitable for bigger and complex projects
- Not suitable if the requirements are not consistent.
- No working software is produced in the intermediate stage.
- No provision for doing risk analysis so uncertainty and risks are there. (What Is STLC V-Model?, 2020)

➢ **A prototype** is a software model that works with a limited number of functions. The prototype does not always hold the exact logic used in the actual software application and is an additional effort that should be considered according to the effort estimate.

✓ Advantages:

- Increase user engagement in the product even before deployment.

- Since the operational model of the system is displayed, the user has a better understanding of the system being developed.
- Reduce time and costs as errors can be detected much earlier.
- Faster user feedback available leads to better solutions.
- Missing functionality can be easily identified.
- Confusing or difficult functions can be identified.

✓ Disadvantages:

- The required analytical risk is insufficient due to too much dependence on the prototype.
- The user may be confused between the prototype and the actual system.
- In fact, this methodology can increase the complexity of the system as the scope of the system may expand beyond the original plan.
- Developers can try to reuse existing prototypes to build actual systems, even if it's not technically feasible.
- The effort to invest in building the prototype can be overwhelming if it is not properly monitored. (SDLC - Software Prototype Model, n.d.)

My team choose V-model because it works well for small and medium sized projects. The experiment is started from the beginning so the ambiguous points are identified in the first place. Easy to manage as each phase has well defined Objectives and goals. That my project has identified its goals.

Conclusion

In this research paper my team have been studying the use of software development tools and techniques. My team outlined its advantages and disadvantages. Then my team identified which tools and techniques It was selected to develop this application: Draw.io, heroku, Node.js, SQLite, V-model and the reasons for its selection.

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