UTM

UNIVERSITI TEKNOLOGI MALAYSIA

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Course:	**SECP1513**
Section:	**09**
Group:	**2**
Assignment Title:	**PROJECT - PART 2**

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Introduction

Presently, we are going through the 4th Industrial Revolution. As such, there are many new technologies and innovations which are now able to be utilized like never before. However, proper implementation of these technologies are still challenges which have to be overcome in order to fully utilise these technologies. Thus, the project we will be working on is about how the healthcare industry could benefit from proper implementation of technologies such as cloud computing, artificial intelligence(AI), and internet of things(IoT).

In order to carry out this project, we will be creating a low-fidelity prototype, which is essentially creating a simple sketch to help visualize how the project will operate. Our low-fidelity prototype will be based on the 4IR technology. The application that we choose is smart health care . Based on the client's problem, we designed an architecture to solve the problem. We proposed the client to use cloud computing since it is beneficial while also keeping costs relatively low.

Detail steps and descriptions related to the project

Team working

Project 1 Report

On the 19th of December 2021, we had a little meeting and we discussed about Project 1 and what we're going to do in this project which is about 4th IR technology and some application of this technology in real life, and this project is consisted of two parts, As soon as we got the ideas of this project we immediately started working on it.

As a group of five members, we helped each other out and divided the work between us.

Here are the names of (Group 2) members and what each of us has done in this project.

- Ammar Bin Jamalludin : he was responsible for introduction and conclusion
- Wong Xiu Ying : she was responsible for the description of 4th IR technology (which was mainly about AI and IoT) and she did the solution (smart health care system).
- Lai Foo Zheng : he was responsible for AWS architecture design, he created the layers for the architecture and the diagram based on the problem proposed added and linked AWS services for each part and added descriptions for what each layer does.
- Saeed Abdullah Bahattab : he was more like an assistant to the other members and he took the checking task which mainly focused on checking for the correctness of information.
- Ahmed Sherif Ahmed : he assists Wong in 4th IR technology with definitions, ideas etc.

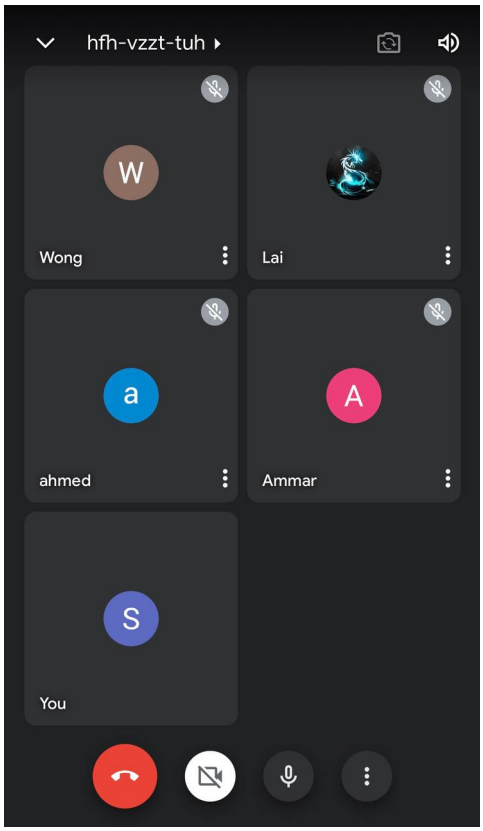
And that was for the first part (project 1 part1)

On the 16th of January 2022 we started working on the second part of the project (project 1 part 2).

The second part was consists of :

- Introduction & report which is done by Saeed Abdullah Bahattab
- AWS Architecture design which is done by Lai Foo Zheng
- Business process flow diagram and description which is done by Wong Xiu Ying
- Provides low-fidelity mock-ups which is done by Ammar Bin Jamalludin and Ahmed Sherif Ahmed

Creating this project was challenging and fun at the same time, especially when you have a brilliant group members that understand each other well and cooperate with each other, we supplied each other with ideas through Google meet app. And we've set goals that need to be done within a specific time to be more accurate about the content of this project



We worked very well as a team and divided everything equally until we finished our final project on the 23rd of January 2022.

Project description

Problem

Since the entry of smart healthcare, developed concepts and systems have been shaped. In any case, with the rise of unused advances and unused issues, there's still impressive room for advancement, and numerous challenges are presently developing.

- Currently, smart healthcare needs large-scale direction and automatic reports, which leads to a large amount of data. In addition, restorative education requires uniform measurements between separate premises and different organizations, and progress is needed to ensure judgment on the information. The sum of information is as well complicated and as well huge, which leads to challenges in information sharing and communication.
- There are two issues with compatibility between distinctive stages and gadgets. From a patient's viewpoint, smart healthcare requires pertinent lawful standards, and there are dangers concerning individual data and protection breaches. Some customers do find it difficult to use the innovation.
- Taking a few advances related to SHREWD healthcare are still within the test stages and require a huge sum of financing to be maintained and updated. There is a lot of data stored since there is a lot of data collected from different devices, which leads to insufficient size in data centres. Hence, the client needs to invest in building new data centres to store more data, the client also needs to maintain the data centre every month which will require a lot of cost.
- There's moreover an obscure hazard if connected carelessly and because of Covid-19, there is a burden on the doctors physically and mentally because of the huge amount of patients that came every day.

Summary of the problem

- Hard to manage the data from many sources and huge amounts of data to store.
- Security issues.
- The data centre needs to be maintained continuously and is costly.

Solution

Smart healthcare

Our group decided to choose AI and IoT by applying it in smart healthcare. IoT can acquire data from a variety of sources that is accurate and free of errors. The AI learns from the patterns formed and imitates how humans finish tasks. AI technologies are embedded into IoT devices to supplement solutions and offer intelligence to IoT. The combination of these two technologies gives the healthcare sector a huge advantage. The technology enables the hospital to benefit from the information of big data.

Thanks to the digital transformation of the health sector, the hospital is able to increase productivity, improve patient satisfaction, and provide more flexibility. Smart healthcare uses the Internet of Things(IoT) to let patients and clinicians connect with one another. The system also allows the interaction of patients and doctors onto a single platform for intelligent day-to-day health monitoring.

1. Monitor patient's health conditions on a daily basis.
    - The system takes advantage of IoT by embedding the sensor in a wearable device. The wearable device may track the patient's heart rate, sleep quality, breathing patterns, and other vital health data.
    - The IoT system thus enables the doctor to monitor the patient's condition from any location, even if the patient is not in the hospital.
    - The AI system will also keep alert of the patient’s condition when it is in alarming condition. The data is collected by the IoT system. The AI will analyse the patient's health pattern and generate a report. The AI technology analyses the pattern and requirements, providing feedback and direction for the patient and doctor. It facilitates real-time action by allowing for real-time analysis.
    - This eliminates the need to manually track the patient's health in the hospital, which is time-consuming. Freeing up the health staff for more critical work.

2. Virtual care.
    - Allow patients to communicate with an AI assistant through a chat box. Chat boxes can deal with minor health issues.
    - Patients do not require making appointments with their doctors. Sometimes the patient's problem could be a minor one that they can handle on their own. This allows the doctor to concentrate on more major matters.
    - Patients benefit from the chat box because it provides an immediate response to their questions and concerns, and it is available 24/7.
    - The patient does not need to visit the hospital or seek medical advice, which reduces the frequency of unnecessary clinic visits.

3. Aids in clinical decision-making.
    - The Internet of Things (IoT) technology enables the system to connect many users such as patients, health workers, hospital management, diagnostic centres, and insurers, speeding up data flow.
    - In terms of medical histories and reports, the data in the system is extremely well-organized. Allowing health-care workers to quickly and efficiently access data, even though the data is large and complicated.
    - The technology can also help staff make better decisions by providing early detection of a patient's health, since the system monitors the patient's condition from time to time.

4. Keep track of every patient in the hospital.
    - When the hospital gets overcrowded, particularly when there is an influx of patients infected with Covid-19, it is hard to determine which patient has the most critical issue and require immediate assistance. The process is difficult since it involves analysing a large amount of patient data and making decisions in a short amount of time.
    - IoT, on the other hand, will collect the patient's data in the system. When the patient's condition begins to deteriorate, the AI will assist in determining the condition and will warn the doctors. The AI virtual

assistant will also take care of patients who do not have any major issues.

AWS Architecture Design

Solution

Cloud computing will be used in smart healthcare. Amazon Web Services is the cloud computing service provider that we have chosen (AWS). This is because the client does not have to develop a data centre and does not have to invest for data centre maintenance. AWS also offers a great deal of flexibility and scalability because you only pay for what you use. Providing a simple way for the hospital to keep its data since the storage demand for IoT is high. AWS also provides a secure cloud computing platform.

Moving a healthcare system to the cloud is not an easy task, as there are a lot of systems in place that need to be changed. Therefore, we suggest the typical 4-layer design architecture for a healthcare system with the addition of one additional AI layer, making it 5 layers. Each layer will depend on the subsequent layer. Adopting Software as a Service (SaaS) is in the hospital's best interests, as they do not need to worry about infrastructure, and it is the easiest to start with.

The frontend platform is the user interface which the customer, sensing device and healthcare workers use this platform to access the cloud. Users can interact with the system by using apps in smartphones or browsers on a laptop or computer. The communication between our AI assistant in the chat box also is in the frontend.

The frontend and backend communicate with each other through the Internet. The backend is the part where it will run on the cloud, which is the AWS Services.

The 5-layer architecture:

1. Sensing Layer

    - Collects health-related information from the patients through wearable
    - Gathers health data including blood pressure, temperature, blood sugar level etc

- Generate the real-time data
- Core IoT technology
- Data transmission depends on the required power consumption
- Main communication layer receives all this data and transmit it via the Internet or store at a cloud platform

2. Communication Layer

- Responsible for all telecommunication services and access
- Allows IoT systems to function
- Wireless networks and broadcasting networks (Provide high speed and reliable internet connectivity)
- Wi-Fi builds a network very fast and easily. Hence, Wi-Fi is applied in the communication technology
- Provides huge capacity, robust internet facilities, and storage of huge amounts of data and sharing the information among the doctors and patients
- Transmit the data to the remote server

3. Data Integration Layer

- Handles resources for medical data of patients and doctors
- Directly uses cloud computing platforms, distributed data storages
- Allows information sharing, data processing, predictive modelling and data analysis with the help of IoT applications and devices. This is required for the AI layer

4. AI Layer

- With cloud computing in the picture, big data analysis, which is required by AI, is much more accessible and affordable.
- Performs situation assessments on patients and provides suggestions to medical professionals.
- Intelligent decision-making and assistance.
- Critical in terms of assessing patient situations, recognizing a course of action, and communicating with the health care provider and patient.
- Aid in virtual care by analysing the information collected from the patient.

5.Application Layer

- Provide the features of dashboards, virtualize the data collected from the sensor.
- Platform for personal health records, smart monitoring & tracking.
- Allowing data to be accessed and displayed by both patients and doctors through the cloud.
- Utilizes websites, IoT devices, and applications.

AWS services:

Storage:

- The Amazon Simple Storage Service (S3) is the world's largest and fastest object storage service. It is suitable for constructing a data lake. Clients can utilize native AWS services to execute big data analytics and artificial intelligence with a data lake created on Amazon S3.
- The Amazon S3 Glacier storage classes are very useful for data archiving, retrieval flexibility, and it saves a lot of cost. The S3 Glacier storage classes provide the quickest access to your archive material as well as the most cost-effective archive storage in the cloud. Hospital systems must store a huge amount of patient records for decades. The Amazon S3 Glacier makes it possible to securely archive patient record data at a minimal cost. The Amazon S3 Glacier Instant Retrieval storage type is perfect for retrieving medical records or genetic data in milliseconds.

Database:

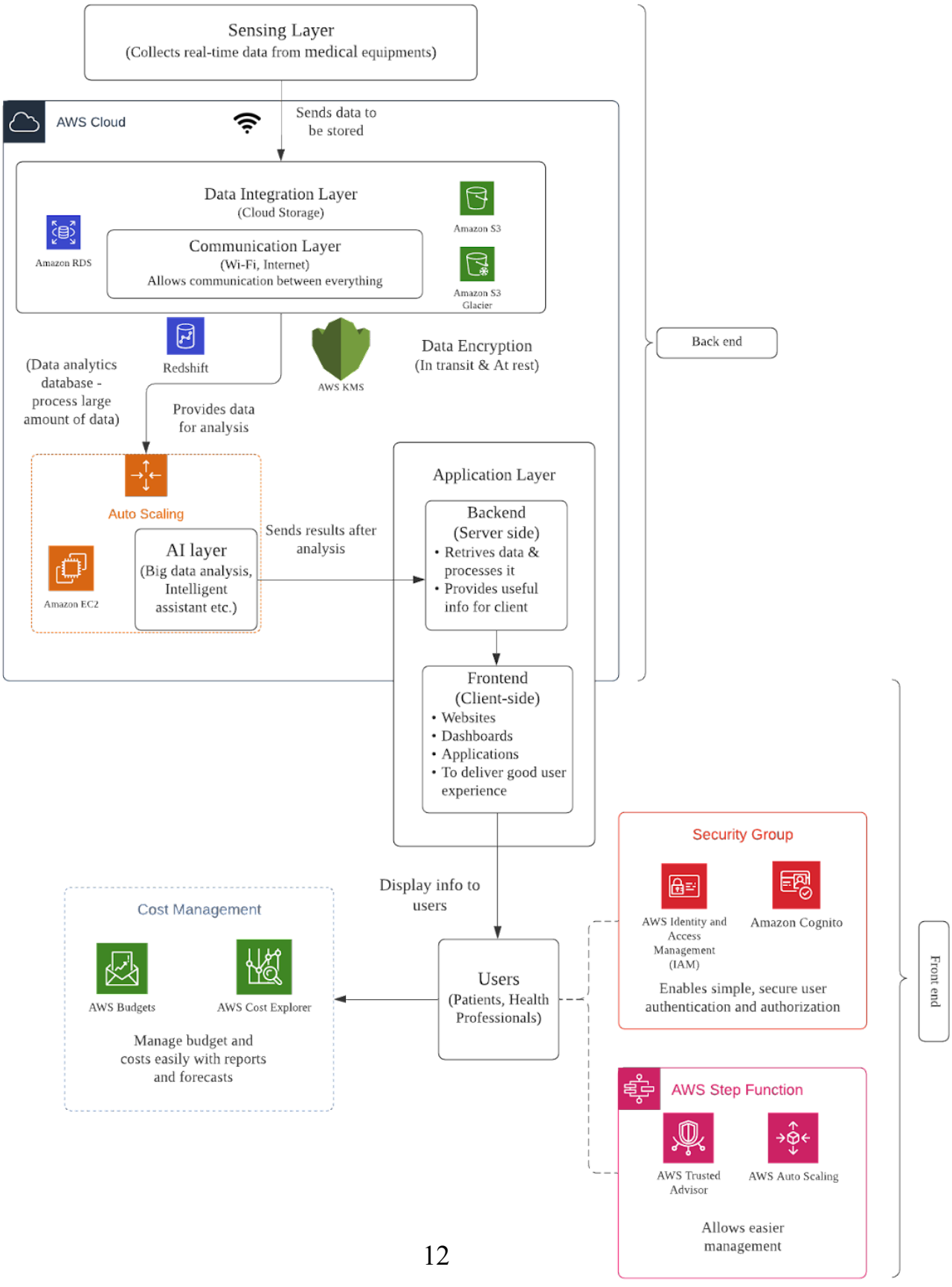
- To create online analytical queries and processing databases, a data warehouse is required. Amazon Redshift is the suitable solution in this scenario. Amazon Redshift is a data warehousing solution from Amazon Web Services. It allows real time analysis.
- Amazon RDS (Amazon Relational Database Service) makes it simple to set up, manage, and scale a relational database in the cloud. It offers scalable and cost-effective capacity. It is highly scalable and customers can scale their database's compute and storage capacity with minimal downtime.

Auto scaling:

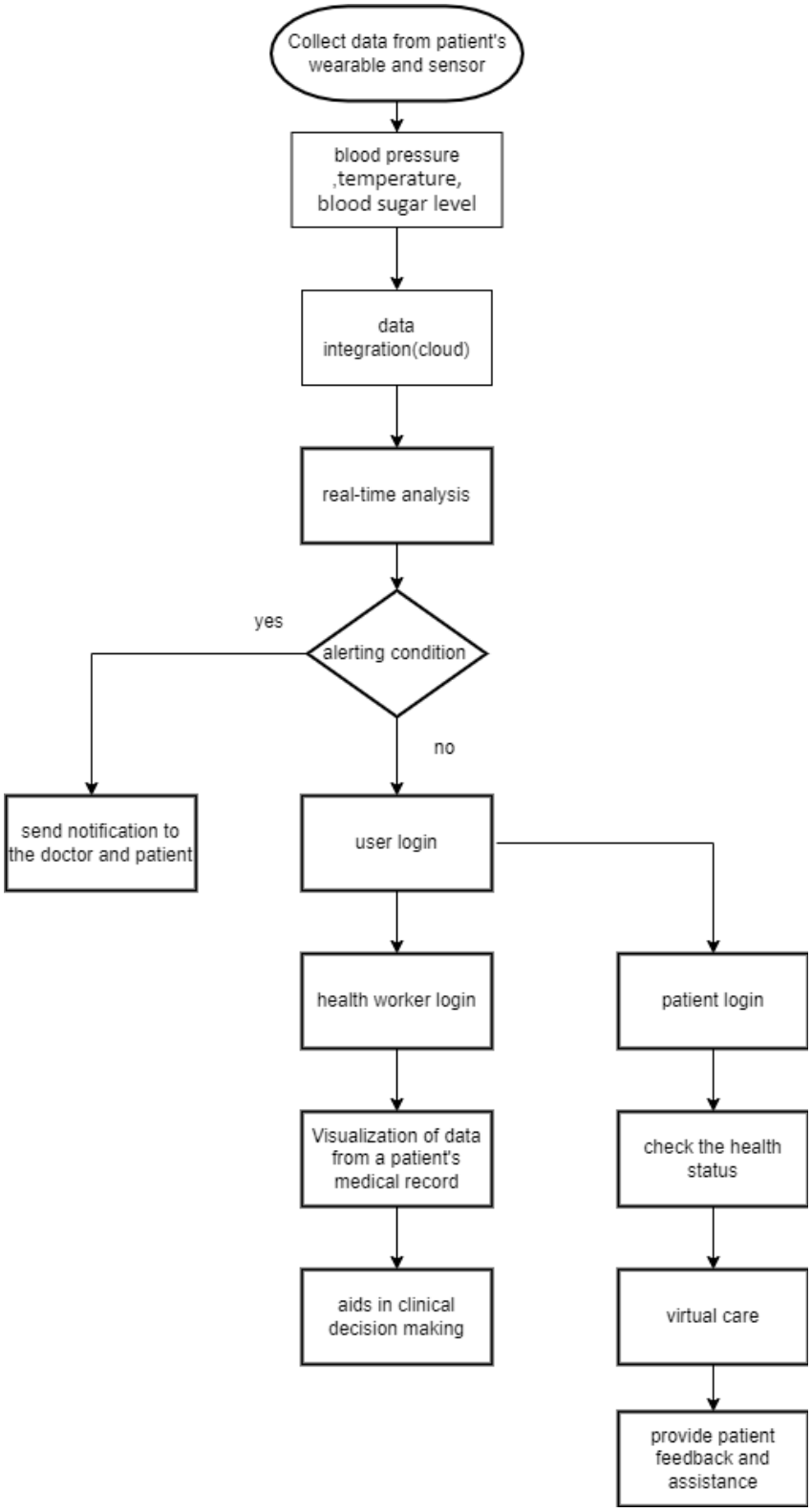
- Amazon EC2 Auto Scaling is an Amazon Web Services (AWS) feature that is very useful in the healthcare system since the data in the system is huge, especially in this ongoing pandemic. It helps maintain application availability by automatically adding and removing EC2 instances based on your need. It also helps to save resources and cost.

Security in the Architecture:

- Blocks unwanted visitors that infiltrate medical records.
- Only granting access to registered professionals.
- Amazon Cognito offers methods for controlling access to AWS resources from the app.
- For the web and mobile apps, Amazon Cognito handles the user login and authentication. The users can log in using their own username and password that they have registered or through a third-party service like Facebook, or Google. This is suitable for our smart healthcare system since we have thousands of users.
- AWS supports data encryption at rest and data in transmit to protect digital data. AWS Key Management Service (AWS KMS) is used to manage the secret key.


Sensing Layer
(Collects real-time data from medical equipments)
AWS Cloud
Sends data to be stored
Data Integration Layer
(Cloud Storage)
Amazon S3
Amazon RDS
Communication Layer
(Wi-Fi, Internet)
Allows communication between everything
Amazon S3 Glacier
Back end
Redshift
(Data analytics database - process large amount of data)
AWS KMS
Data Encryption
(In transit & At rest)
Provides data for analysis
Auto Scaling
Application Layer
Backend
(Server side)
• Retrives data & processes it
• Provides useful info for client
Sends results after analysis
AI layer
(Big data analysis, Intelligent assistant etc.)
Amazon EC2
Frontend
(Client-side)
• Websites
• Dashboards
• Applications
• To deliver good user experience
Security Group
AWS Identity and Access Management (IAM)
Amazon Cognito
Enables simple, secure user authentication and authorization
Display info to users
Cost Management
AWS Budgets
AWS Cost Explorer
Manage budget and costs easily with reports and forecasts
Users
(Patients, Health Professionals)
AWS Step Function
AWS Trusted Advisor
AWS Auto Scaling
Allows easier management
Front end

Business process flow diagram and description



Medical IoT allows patients and devices to be connected in order to provide actionable information that improve patient care.

1. First, the smart healthcare system will collect data from patients via wearables and sensors from time to time. Wearable technology allows for remote monitoring of a variety of health indicators and data. Wristbands, for example, can be used to take a variety of measurements, including temperature, blood sugar level, and so on.
2. Next the data collected will be stored in the cloud and the AI will analyse the data.
3. The system will monitor the patient on a regular basis and do real-time analysis. IoT technology allows medical staff to communicate in real time, allowing them to stay informed and vigilant. This allows medical staff to be ready in the case of an emergency.
4. The system will raise an alarm and advise the patient to visit the hospital for a check-up if the patient's condition is critical, such as if the temperature is too high. Healthcare experts may be able to make wiser and faster treatment decisions with real-time patient data, avoiding emergency cases.
5. When the user logs into the system, the user needs to key in the password. We prioritize security issues and provide multifactor authentication as well as continuous, real-time, and comprehensive cybersecurity protection. At all costs, patient data and privacy must be safeguarded.
6. When a health worker logs into the system, they will have access to the patient's accurate, current, and comprehensive electronic medical report. This visibility provides vital information to health-care providers and allows them to communicate with patients.
7. This aids in the making of clinical decisions.With real-time patient data, medical experts may be able to make smarter and faster treatment decisions, averting emergencies.
8. When a patient logs into the system, they can check their health status and receive assistance from our virtual care assistance. Patients gain a better understanding of their health status and are able to make better decisions as a result.

Low-fidelity mock-up

To have a better viewing experience, please click this link:

[Prototype Preview]

Reflections

a. What have you learned and your motivation to complete this project?

The one question that we have been constantly asking ourselves while doing this project is what have we learned after coming this far, and what motivates us to do so? In hindsight, we learned a lot of things as well as gaining new knowledge and experience along the way. Brainstorming new ideas, exploring and experimenting with multiple prototypes, improving them and actually building them as low fidelity prototypes. We also have a deeper understanding of the AWS service and how useful cloud computing is. We get a better understanding on cloud architecture, for example the difference of front end and back end. Furthermore, we learn how technology helps us in life and the usefulness of IOT and AI.The thing that drives us to do all this despite the sheer workload is actually very simple. It is because it feels fulfilling to create something with our own hands, that feeling of being productive and improving ourselves and to share it with others.

b. What issues and solutions are implemented to make the project a success?

The issues that we faced while doing this project includes us not having prior knowledge to the project at hand. With little understanding of the topic, we are required to build a solution to an existing problem. The only thing we can do about that is to learn, and so we did. We went through the AWS courses and looked for examples online to try and integrate them into our proposal and make it into our own. I would say that we did quite a good job for that matter.

One of the other issues that keeps popping up is the fact that all of us can't meet face to face due to restrictions in place. Discussions and brainstorming sessions can only be held online, and most of the time it wasn't as eventful as it should be. Well, that can't be helped, but at the very least, we managed to complete the project by completing the task delegated to each member, being proactive and engaging in discussions whenever we have the time. I would say that this was a team effort, by having a good attitude and mindset, we are able to go through with most of the challenges thrown at us.

c. What is your direction after completing this project?

After completing this project, our direction is to learn more about AWS as well as learning how to use a variety of software in order to broaden our skill sets. This is

because we felt very accomplished as we had managed to complete all the tasks with great success despite it being the first time learning about AWS as well using Figma to create a low-fidelity prototype. We felt that by learning more about AWS as well as a variety of software will greatly assist us in the future.

d. What is the improvement necessary for you to improve your potential in the industry?

First and foremost, we must strengthen our analytical skills. As software engineers, we will face difficult and complex projects in the future. To solve the problem, we need to strengthen our ability to think critically and analytically.

Creativity is also essential. Employers occasionally look for employees who can come up with innovative ideas. Using imagination to come up with a solution to an issue helps in finding a creative solution. Our team, for example, thinks beyond the box by implementing virtual care into the smart healthcare system. We can improve our procedure and product by thinking creatively. People who can think critically and solve complicated problems are more likely to make smart decisions in both their personal and professional lives.

Not only are hard skills necessary, but soft skills are as well. From time to time, we shall be confronted with a challenge. For example, when building the smart healthcare system, we run into issues. We must be positive and persevere in the face of difficulties.

We must also adapt to change. For example, instead of using a traditional server, we can use the cloud, which offers numerous benefits. Be flexible so that we can adjust to change, which is important in today's fast-paced environment. There will always be new technology developed, and we need to implement it. This can also assist us in reducing our stress levels.