Personalized Application for Dementia Patients in Cognitive Rehabilitation with Continuous Monitoring

D-care

Research Group Details

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Introduction

- Developing an application which consists of games and activities for Dementia patients.
- This application will help to improve the cognitive functionalities of the patients.
- Games and activities will mainly focus the Frontal lobe and Temporal lobe from the cerebral cortex.

Research Problem

- Current prevalence of dementia is 47.5 million worldwide[1].
- There are not any software based solution which can learn from the user behavior and get customized to the user
- The number will nearly double in every 20 years globally.
- Dementia is basically a syndrome which can’t be cured by medicines
- There are not any applications suitable for the Sri Lankan culture
  Language and Images

Comparison with existing Applications

Features	Lumosity 	Brain Games 	Elevate 	Eidetic 	Proposed System
Learning from the user and personalize it	✗	✗	✗	✗	✓
View the daily report	✓	✗	✓	✓	✓
Doctor can view the progress of the patients	✗	✗	✗	✗	✓
Games in Sinhala language	✗	✗	✗	✗	✓
View the history	✗	✓	✓	✓	✓
Suitable for elderly people	✓	✗	✓	✗	✓
Take voice inputs	✗	✗	✗	✗	✓
Based on many functionalities	✓	✗	✓	✓	✗

Main Objective

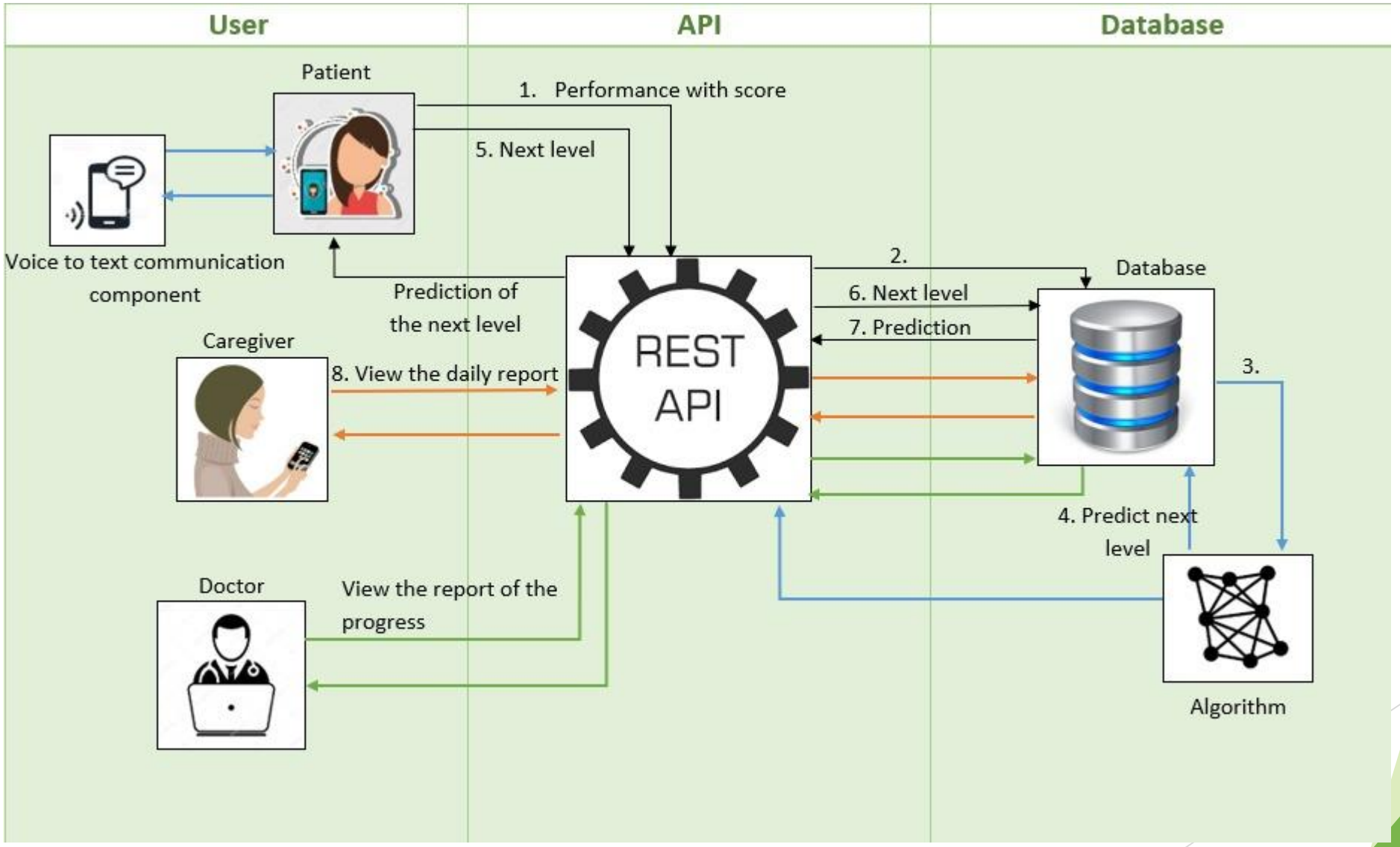
Help the Dementia patients by giving rehabilitation in a cognitive way using different kinds of games or activities by learning from the user aspects which will be implemented in this application with continuous monitoring.

Decrease the mild and moderate stages of Dementia patients

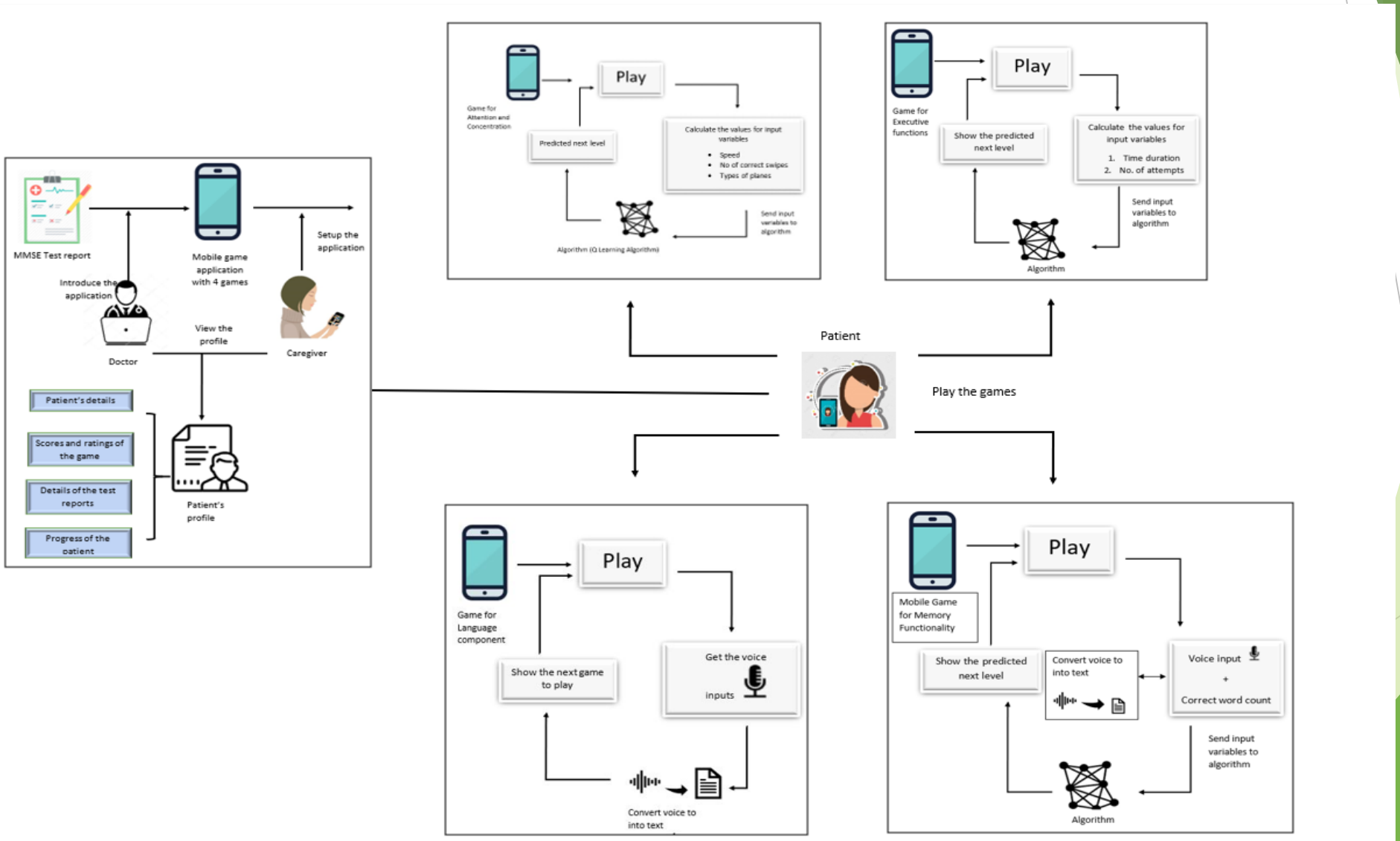
Both patients and caregivers to make their life easier because there is not a special or exact medication for Dementia

Reduce the cost for external caregivers

High Level Diagram of the System



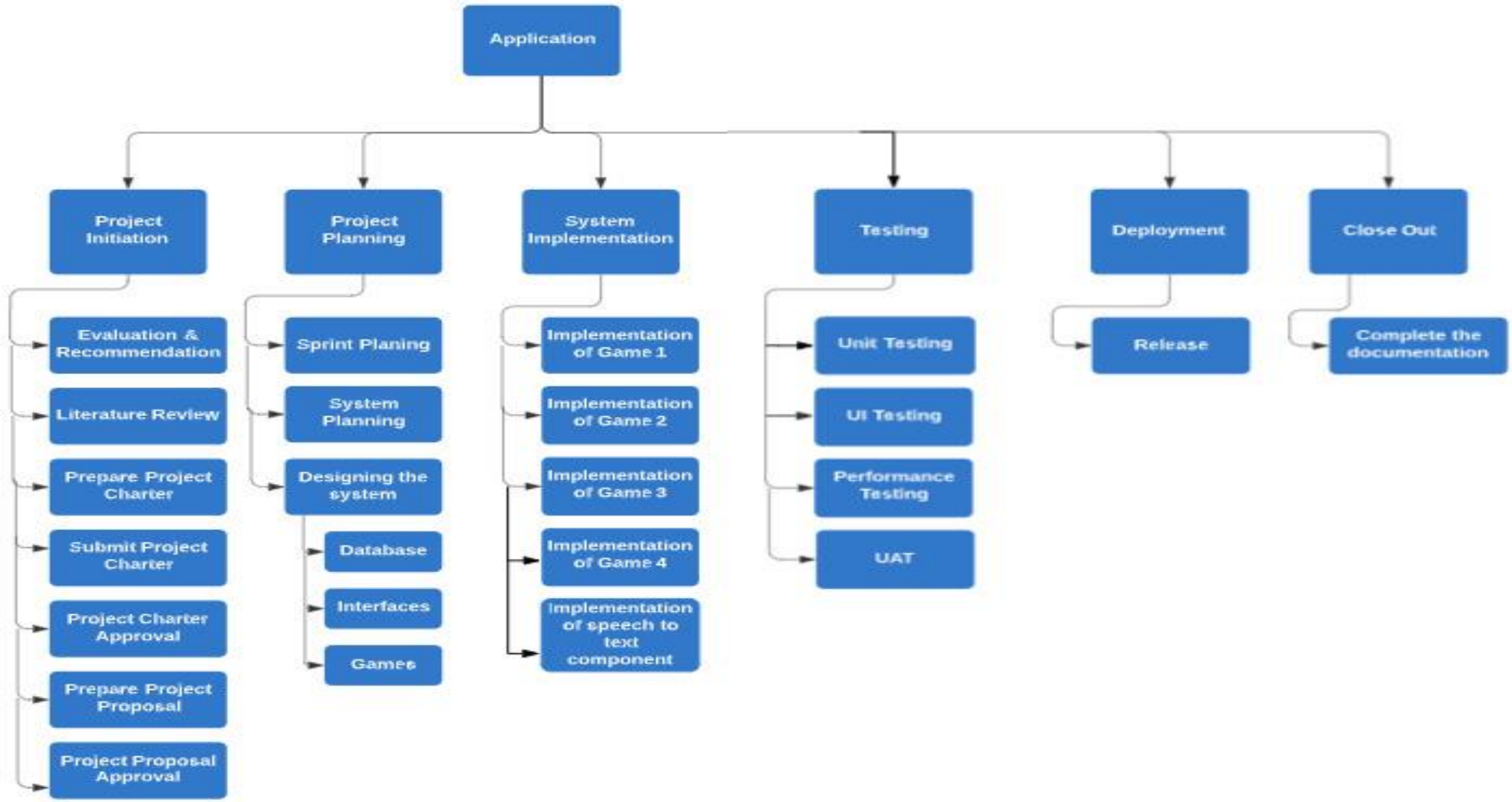
Overview of the System



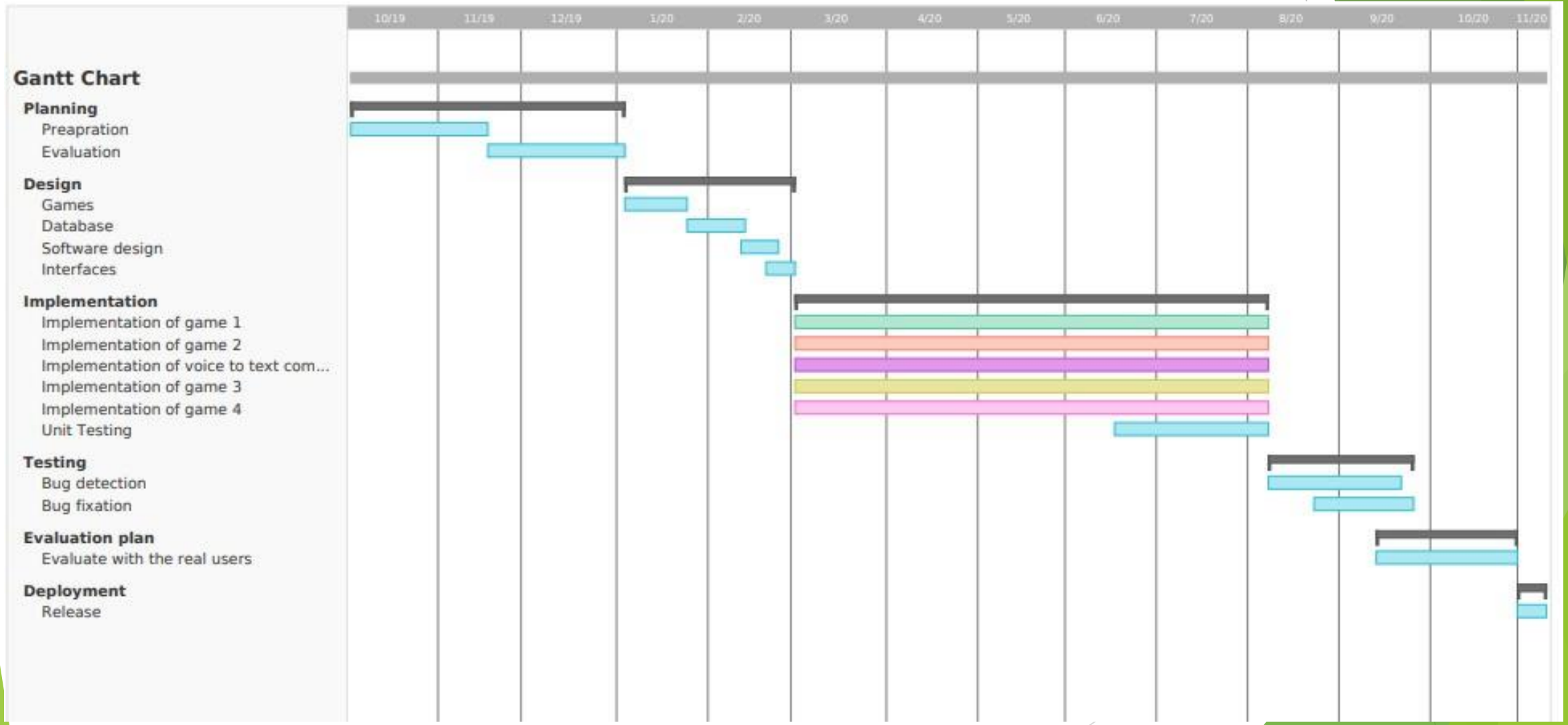
Methodology

- Design the Games and relevant other interfaces.
- Create the database.
- Implement the mentioned Games and Interfaces.
  - Maintain Attention and Concentration of Dementia Patients
  - Improve the effectiveness and speed process of Executive Functions
  - Improve the impairments of Language Skills
  - Maintain the registration, recall, recognition of memory
  - Using reinforcement learning algorithms and getting the positive or negative rewards based on the way how the user plays the game and predict the most suitable next step for the user.
- Connect the client and server.
- Generate the relevant reports.

Work Breakdown Structure



Research Gantt Chart



Technologies and Algorithms

- Python
- TensorFlow
- MySQL
- Flask REST API
- AWS Cloud
- Unity

- Q learning

Requirements

Real world requirement from the Consultant Psychiatric, National Hospital of Colombo.

Functional Requirements

- Login, User profile
- Four main games
- View the progress report

Non functional Requirements

- Performance
- Scalability
- Usability

Expected Outcome

A user-friendly application for the Dementia patients including appropriate algorithms and techniques to learn from the user and provide a customized set of games or activities

Mobile Game to improve Attention and Concentration

Rathnayaka M.H.K.R.
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- Attention
  - Focus on one thing at a time.
- Concentration
  - Controlling the focus of attention

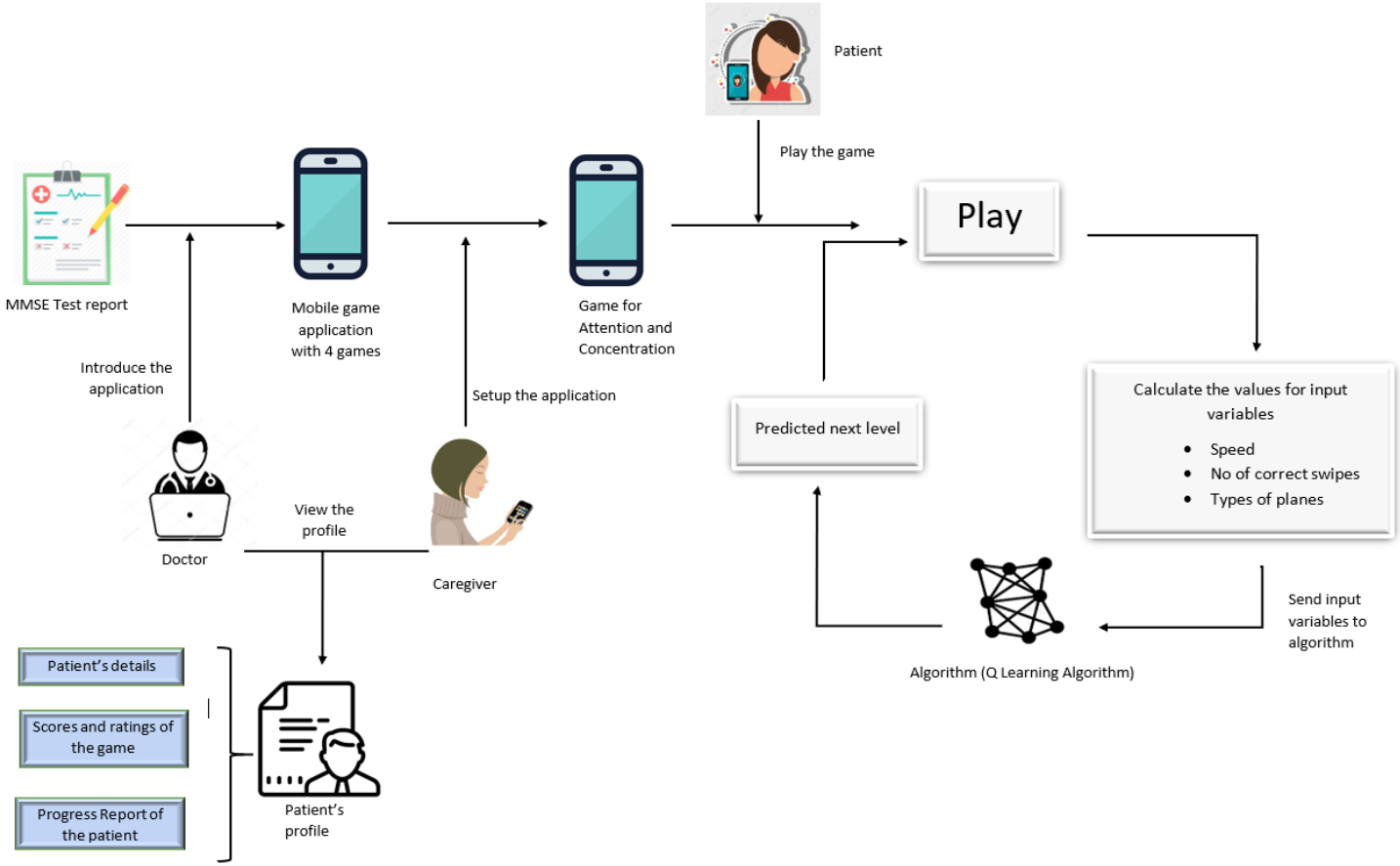
Research Question

- How to help Dementia patients to improve the attention and concentration by developing a mobile game with reinforcement learning?

Objective

- Develop a mobile game for Dementia patients to improve Attention and Concentration and make their life little easier.

Overview of the component



Technologies and Algorithms

- Unity
- MySQL
- Python

- Q learning algorithm

Requirements

Functional Requirements

One main game which includes to improve both Attention and Concentration.

Game should have small tutorial

Attention and concentration levels should be include separately in the reports.

Non functional requirements

Performance

Usability

Accuaracy

Expected Outcome

- Mobile game which can use for Dementia patients to improve their Attention and Concentration in a very user friendly way.

Mobile Game to improve the Executive Functions

Executive functions include the ability to organize, use of proper judgement, plan and do a set of tasks in an effective way.

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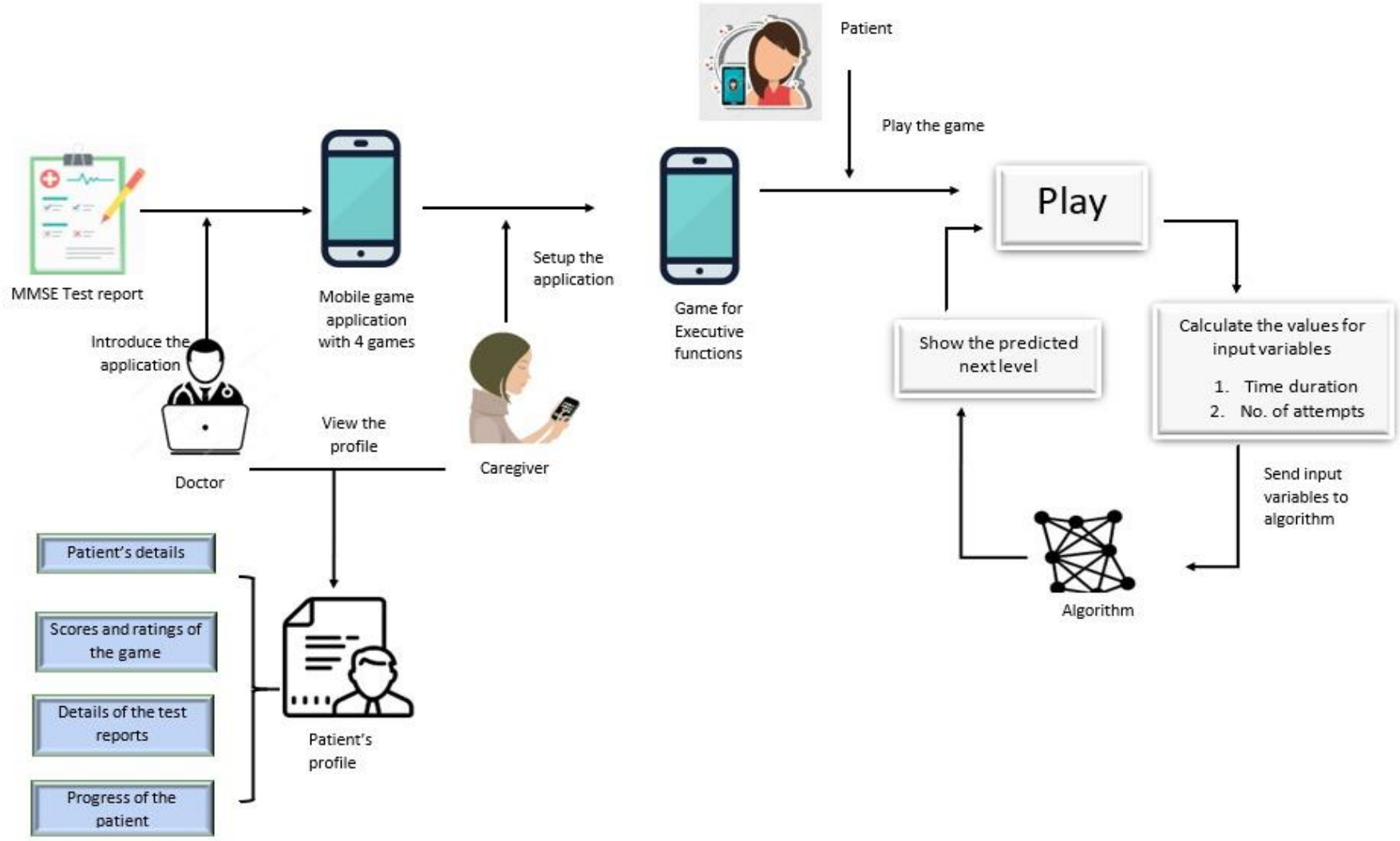
Research Question

How to cover all the aspects of executive functions using reinforcement learning algorithm and help dementia patients to escape their impairments ?

Objective

- Improve all the sub functions (problem solving, decision making, planning, etc..) in executive functions of dementia patients.

Overview of the component



Technologies and Algorithms

- Unity
- MySQL
- Python

- Deep Q learning algorith

Requirements

- Functional requirements
  - Progress of every level in the game
  - Clear instructions before start the game.
- Non-functional requirements
  - User friendly
  - Performance

Expected Outcome of Component

- Develop a user friendly game or activity to improve executive functions impairments of dementia patients.

Mobile Game to improve the Language skills

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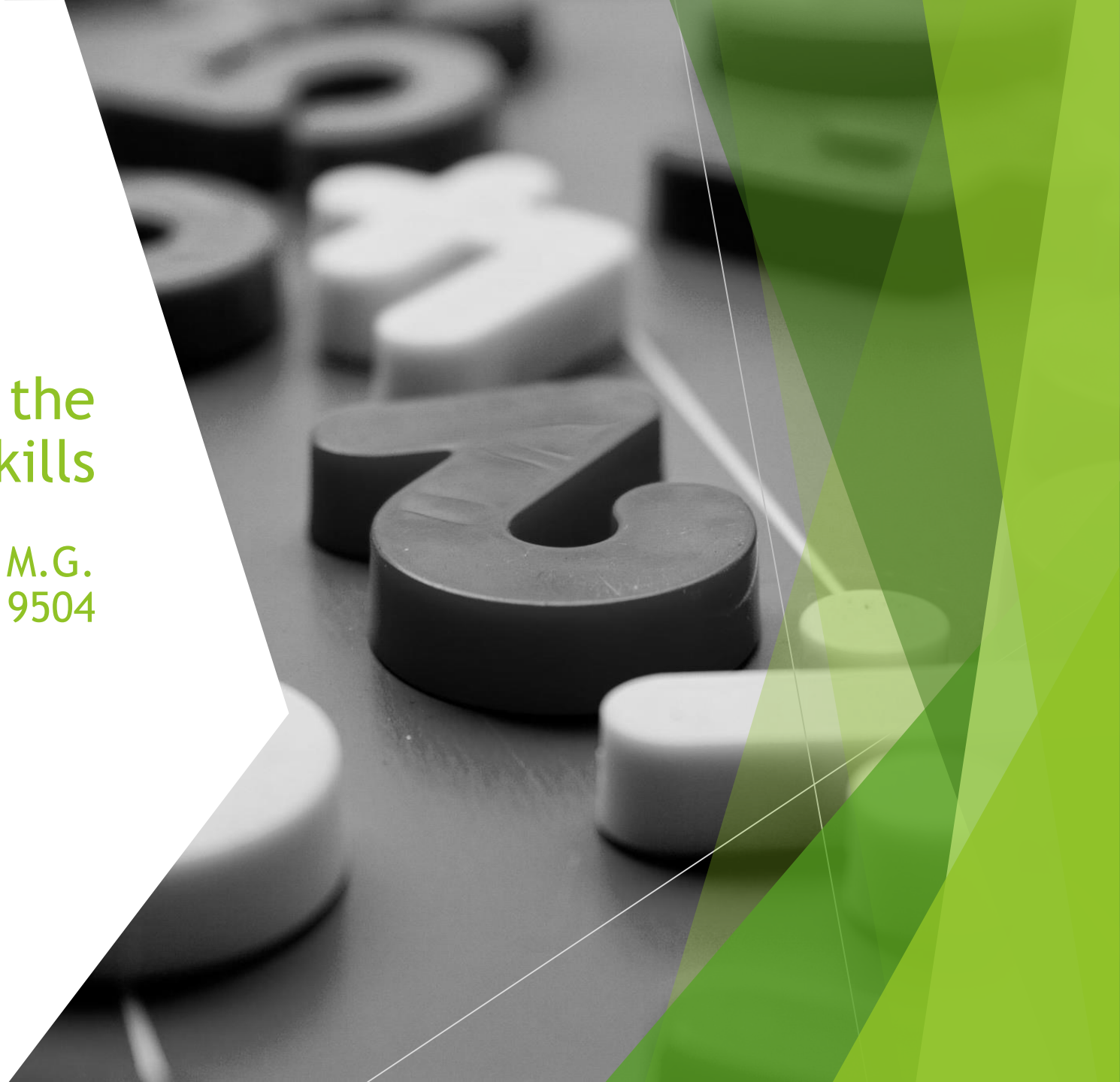


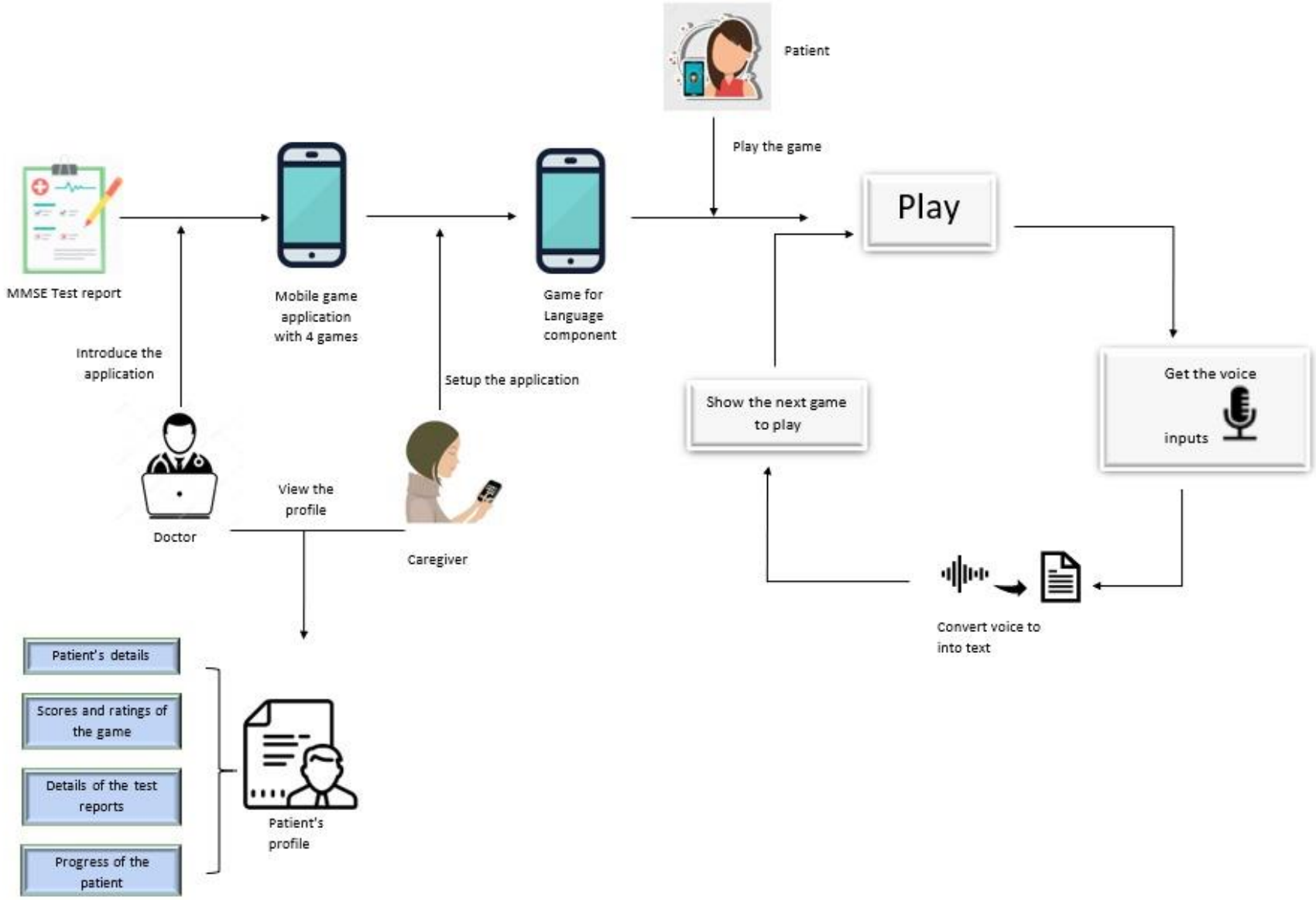
Research Question

- How to give a solution for the impairment of the language skills of Dementia patients using speech to text communication activities to make their day-to-day life easier?

Objectives

- Improve the skills of Dementia patients
  - Reading
  - Writing
  - Comprehension
  - Communication
- Reduce the Language impairment problem

Overview of the component



Algorithm and Technologies

- **Algorithm**
  - Deep Neural Network
    - Convolutional Neural Network
- **Technologies**
  - Unity
  - Python
  - TensorFlow

Requirements

- **Functional Requirements**
  - Get the voice inputs of the user to continue the game/activity
- **Non Functional Requirements**
  - Performance
  - Usability
  - User-friendly

Expected Outcome

- Introduce an application which includes the ability to reduce the impairment of the Language skills of Dementia patients and recover those patients

IT17100076

SILVA. S. R. R. M

Mobile Game to Improve Memory Skills

Research Question of the Component

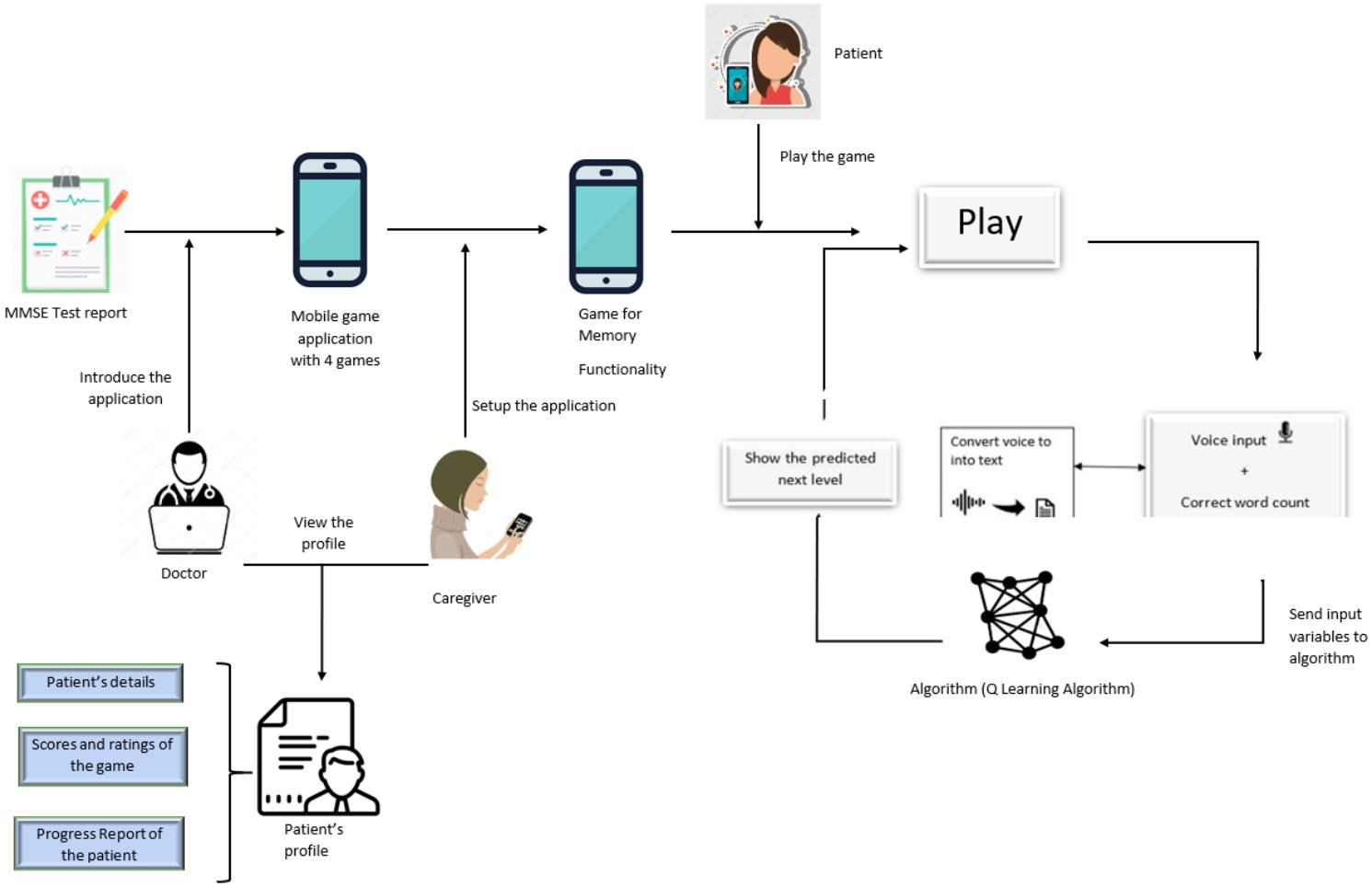
- How does the Reinforcement Learning use to involve in develop Memory Recover/ Improve mobile game application.

Objective of the Component

- Help Dementia Patients to,

  - Recover their memory
  - Improve their memory

Overview of the component



Algorithms and Technology

Unity
MySQL
Python

Q learning algorithm

Requirements

- Functional
  - Memory related mobile game should contains three stages of the each level
  - Should have certain number of levels in the game
- Non Functional
  - User-friendly
  - Performance

Expected Outcomes of the Component

- Eventually public statement a gaming app which is user friendly and help to recover/ improve Dementia patients' memory

Evaluation Plan

- What will be evaluated ?
- How ?
- Why?
- When?

Challenges

- Gaining the knowledge about Dementia
- Designing the Games
- Selecting the most important functionalities for the games
- Select sample users(patients)

Limitations

- Patients in mild and moderate stages only can use the application.
- Need smart phone to install the application.
- Doesn’t have the games for the all the functionalities.

Helping hands to Dementia…

Commercialization

- Introducing the application(**D-care**) to the doctors.
- Explain the benefits of application to the caregiver.
- Patients installing and using the D-care application with the doctor recommendation.
- Patients getting one month trial period.
- Continue the D-care application with small payment.

References

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Thank you…