ASD.AI - Sinhala Dialogue Management Tool to Screen Kids with Autism Spectrum Disorder

2021-006

Introduction to the Overall Project

- Nowadays, conversational systems are becoming pervasive as a basis for human-computer interaction as we seek more natural ways to integrate automation into everyday life. Many efforts have been made to develop highly intelligent human-machine dialog systems since research began on artificial intelligence (AI). Advancements in technology have reached the point where we can use machine learning capabilities to understand and produce human language through an approach called "Conversational AI".
- A tool that predicts ASD from a clinically validated culturally sensitive symptom checklist is proposed by using the conversational AI concept. Multiple machine learning algorithms are thoroughly evaluated on clinical PAAS data, and the best performing algorithm is embedded into the application. The proposed application can be administered by non-specialist healthcare workers too, to advise if a clinical referral is recommended. As more data are collected, the application can be refined and improved with software updates.
- Early identification of ASD in children enables intensive intervention before neuronal pruning is completed. The ASD.AI application embeds an intelligent machine learning model to arrive at a decision. This can be introduced as a novel tool for ASD screening using a culturally sensitive symptom checklist and embedded machine learning model. A variety of supervised learning models were trained on PAAS data collected clinically. The proposed application has shown greater predictive performance than current paper-based methods (PAAS).

Introduction to the Overall Project

- So, the new application is important to improve ASD awareness and detection which incorporates intelligent decision making in combination with a culturally sensitive and clinically validated screening tool is novel, and this combined approach will reduce the burden of the shortage of mental health services. Furthermore, valuable data can be collected about the prevalence of ASD and resources allocated correctly to decrease treatment delays.
- The proposed conversational AI consists of main four components namely speech recognition, natural language understanding, dialogue management and speech synthesis. According to progress of many researches following issues were identified around dialogue management domain as unavailability of support for Sinhala language, ease integration with existing applications, inability to train using previous data and support for custom entity definition. The proposed platform's dialogue management unit will overcome these drawbacks to distinguish itself from the current tools with Sinhala language support being the highlight.

Research Problem

- Day by day the technology becomes better and better, making the life of people easier. But there are some sides which are left untouched. Due to cultural reasons, ASD awareness is low in LMIC like Sri Lanka. ASD detection is poor in this region, compared with developed countries due to research and funding limitations in LMIC. This is a deeply concerning issue, and there is an urgent need for more support and services for these individuals living in Sri Lanka. Early identification and diagnosis are important to improve the clinical outcomes of these individuals with ASD.
- There are over 5000 languages in the world, but the thing is, there are only a few languages in the world that are very common and most used. Most chatbots use English as the primary language due to its usage in the business sector. This limits the experience for those who are not fluent in the English language.

Research Objectives

Main Objective:

The primary objective of the proposed solution is to create a machine learning-based automated autism screening tool to reduce or eliminate error-prone, inefficient human intervention in the field. The proposed system's ability to support both English and Sinhala languages. The system with its efficient and robust performance will have a direct implication on the quality of the service.

Sub Objective 1: High availability

The intelligent agents deployed by the proposed platform can be operational and readily engage with their defined goal 24 hours a day, 365 days a year. As humans are emotional being their current mental status can have a direct implication on the quality of service provided by the human. But with the intelligent agent's probability of this incident occurring is never.

Research Objectives

Sub Objective 2: Handling many requests at a time

With the proposed platform intelligent agents will be deployed depending on the current load of requests to be handled and the agents will have the ability to handle multiple conversations simultaneously compared to their human counterpart.

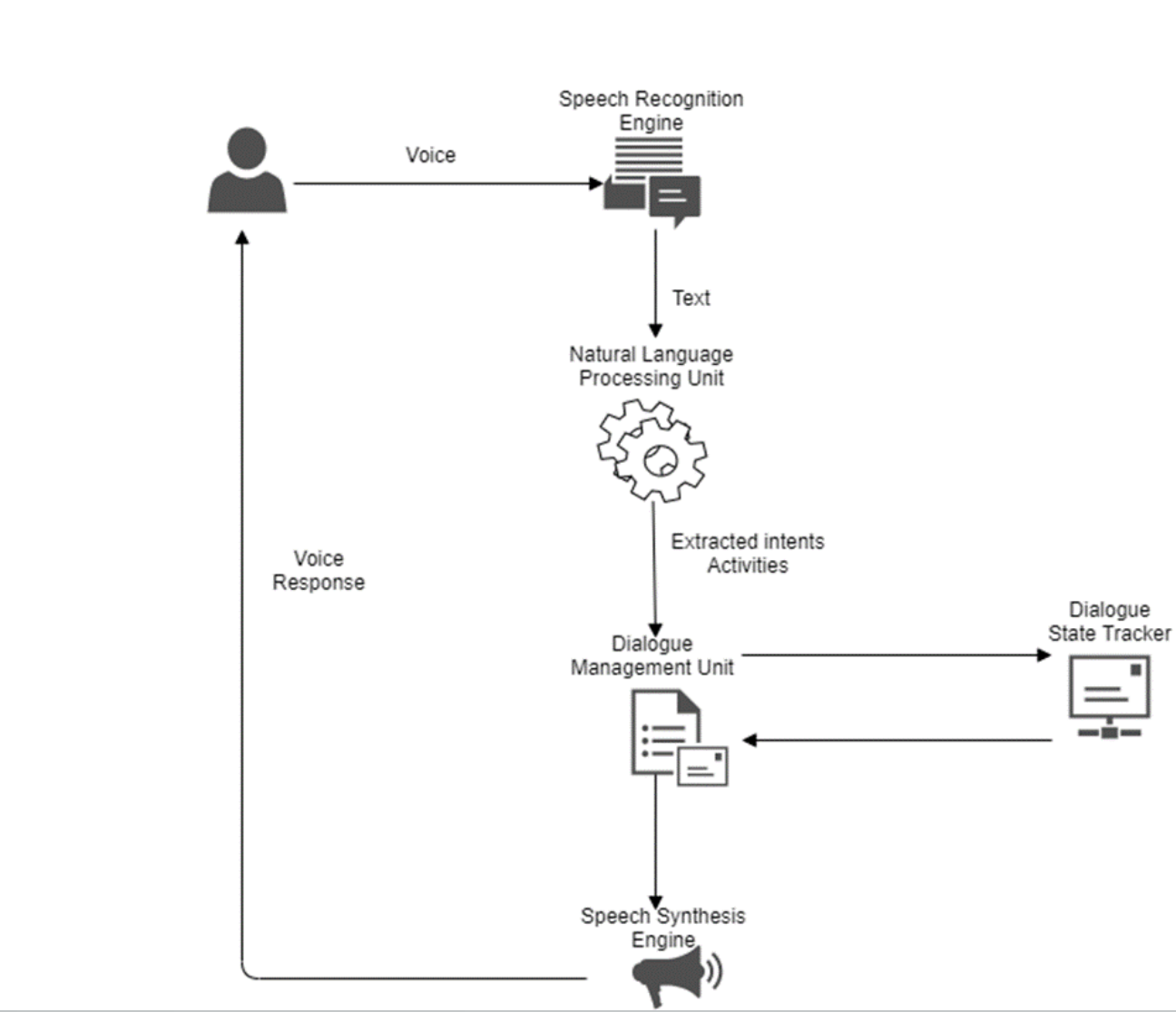
Sub Objective 3: Low in cost

The system is easy to configure to meet different needs from time to time. Once deployed, intelligent agents will ultimately have only little to known maintenance cost compared to current systems. The system will allow easy adaptability across different languages because of the modular platform it was built upon.

Sub Objective 4: The high overall productivity of the service

Intelligent agents once deployed by the proposed platform will be reactive and efficient. Due to the intelligent agent's ability to interact with multiple users at a time, users of the system can gain productivity, time, and scalability.

Overall Solution As a System Diagram



Speech Recognition

1

IT17109536 | Anjali R.P.D.N

Degree of Bachelor of Science Special (honors) In Information Technology Department of Information Technology

Agenda

- Background of Speech Recognition
- Research Gap
- Research Question
- Specific and Sub Objectives
- System Diagram
- Technologies, techniques, algorithms to be used
- System, personal, and software specification Requirements
- Budget (if any)

Introduction

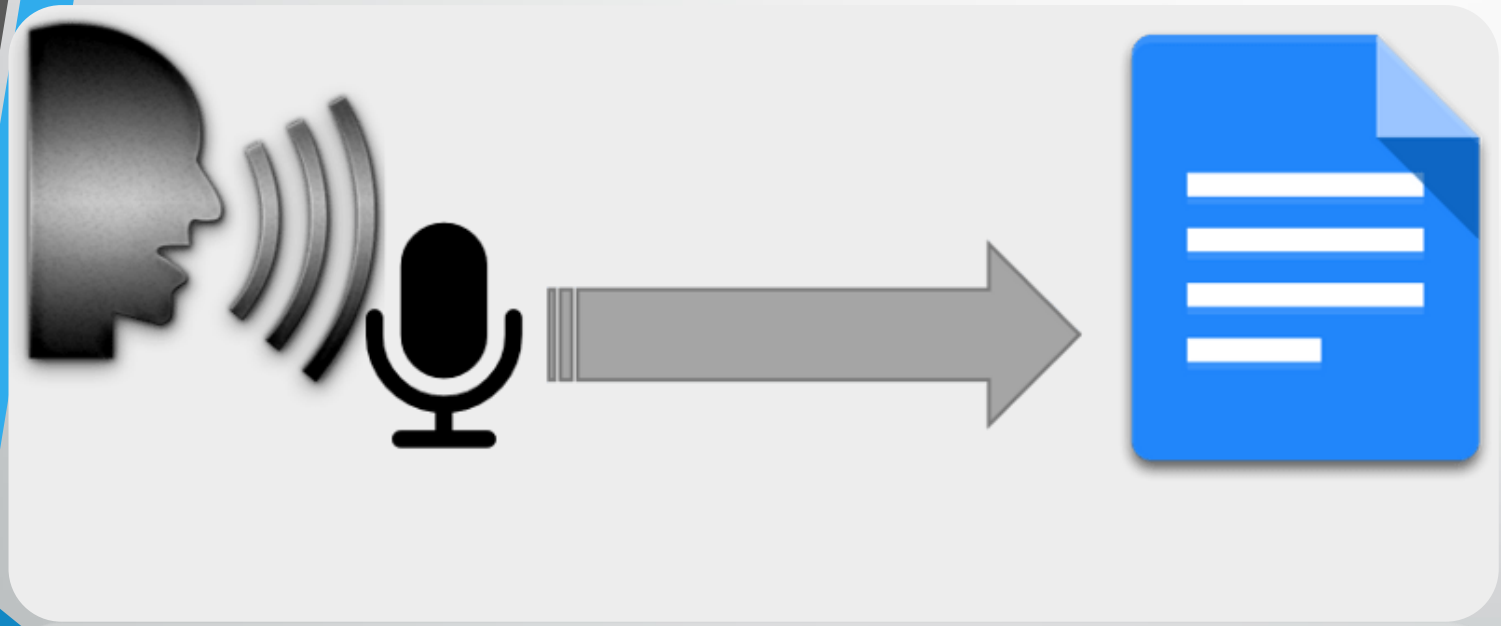
This section MUST include following sections

- Background/Research Gap
- Research Question
- Specific and Sub Objectives

Note: You should use "Individual Title and Content" Slide layout to add the details

Background

What is Speech Recognition?



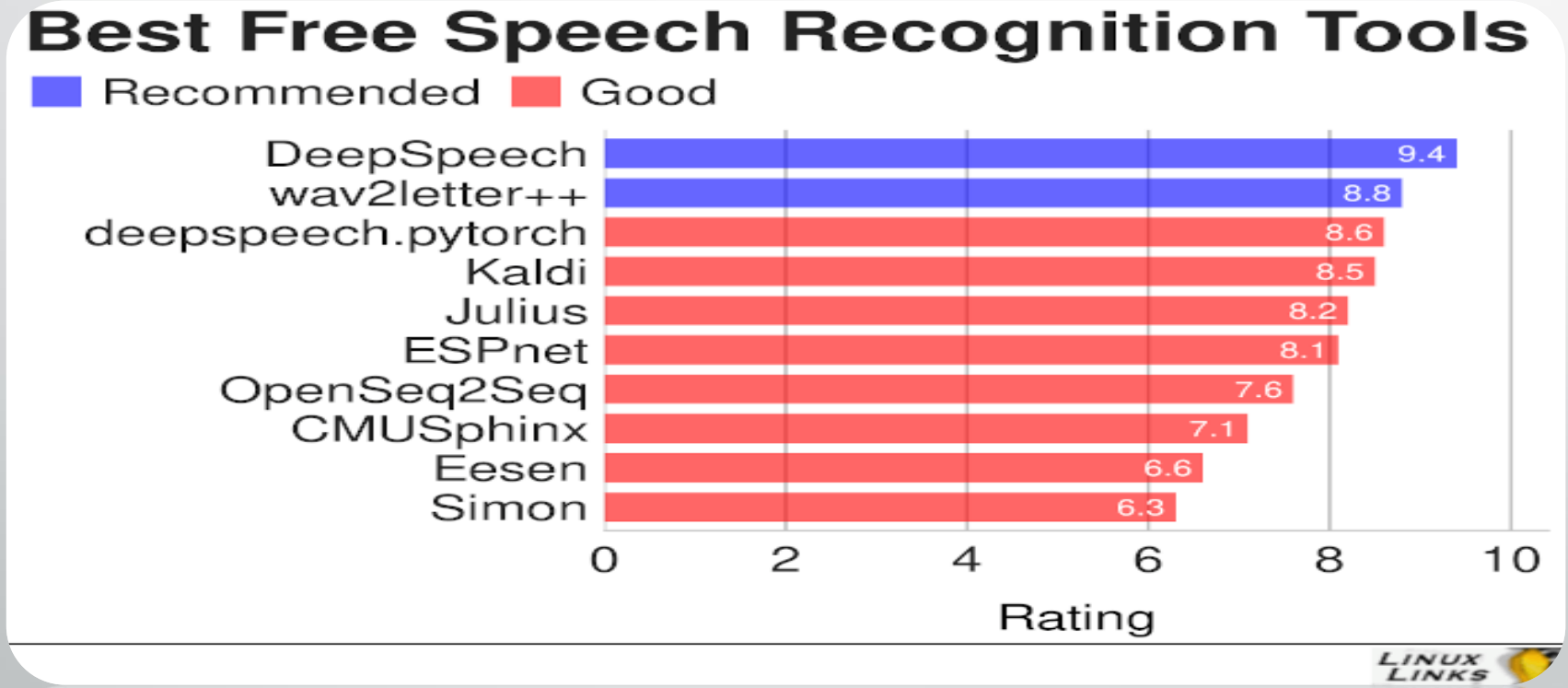
- Convert voice sequences received into text format.

- The system will be implemented based on the Deep Speech 3 implementation by Baidu to support both English and Sinhala languages.

- Recurrent Neural Network will be trained using existing voice conversations using multiple GPUs. Separate language models will be implemented for each language.

Research Gap

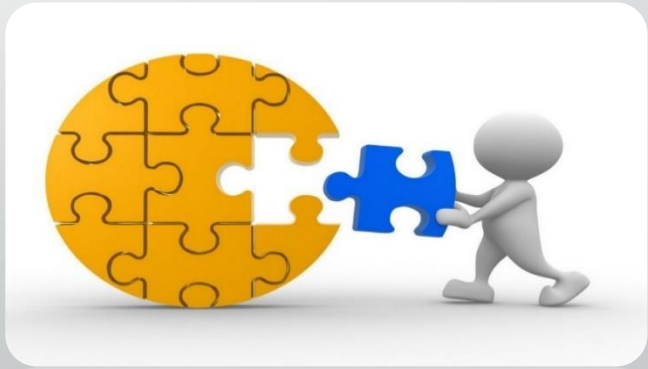
- What are existing Speech Recognition Tools ?



SLIIT FACULTY OF COMPUTING

11/5/2021 14

- Although many of these platforms support languages around the world, we have yet to find a single platform that supports Sinhala.
- Basic Vocabulary of Speech Recognition: Introduce an appropriate way to present a list of words that the system can identify.
- Words: Introduce ways to distinguish a word under different words.
- Accuracy: The ability of a system to recognize a word correctly. Therefore, speech recognition methods are offered to get better text.



Research Problems

- Environment: Background noise

  Background noises make it hard for systems to understand and distinguish between the specific sound waves from the host voice.

- Speaker characteristic: accent.

  If the same word can be pronounced differently, the spelling and phonology of the same word will change, making it difficult for the software to handle.

- Task specifics: Number of word in vocabulary, language constraints.

  The system has a number of recognizable words and is unable to recognize words beyond that language limit.

- Missing words

  If a user speaks louder than the microphone, the software often gets a confusing speech. On the other hand, talking too far away from the microphone leads to missed words.

Objectivity

Main Objective

- And convert voice order to text format

Specific objectives

to avoid the issues discussed in the Research Issues section.

- Find a way to distinguish between specific sound waves from the host according to the background noise.
- If the same word can be pronounced differently, the spelling and phonology of the same word will change and the software will find a way to recognize it correctly.
- Design a number of words that the system can identify and find a way to identify a large number of words that are used on a daily basis beyond those language boundaries.

RESEARCH METHODOLOGY

This section MUST include following sections

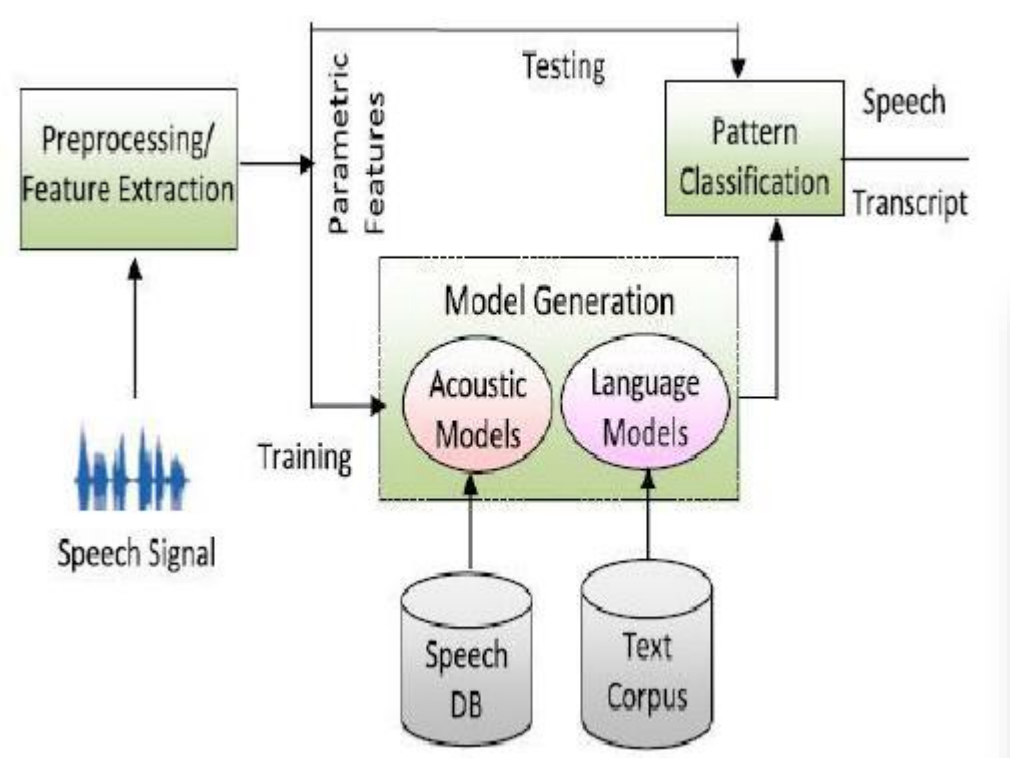
- System Diagram
- Technologies, techniques, algorithms to be used
- System, personal, and software specification Requirements
- WBS

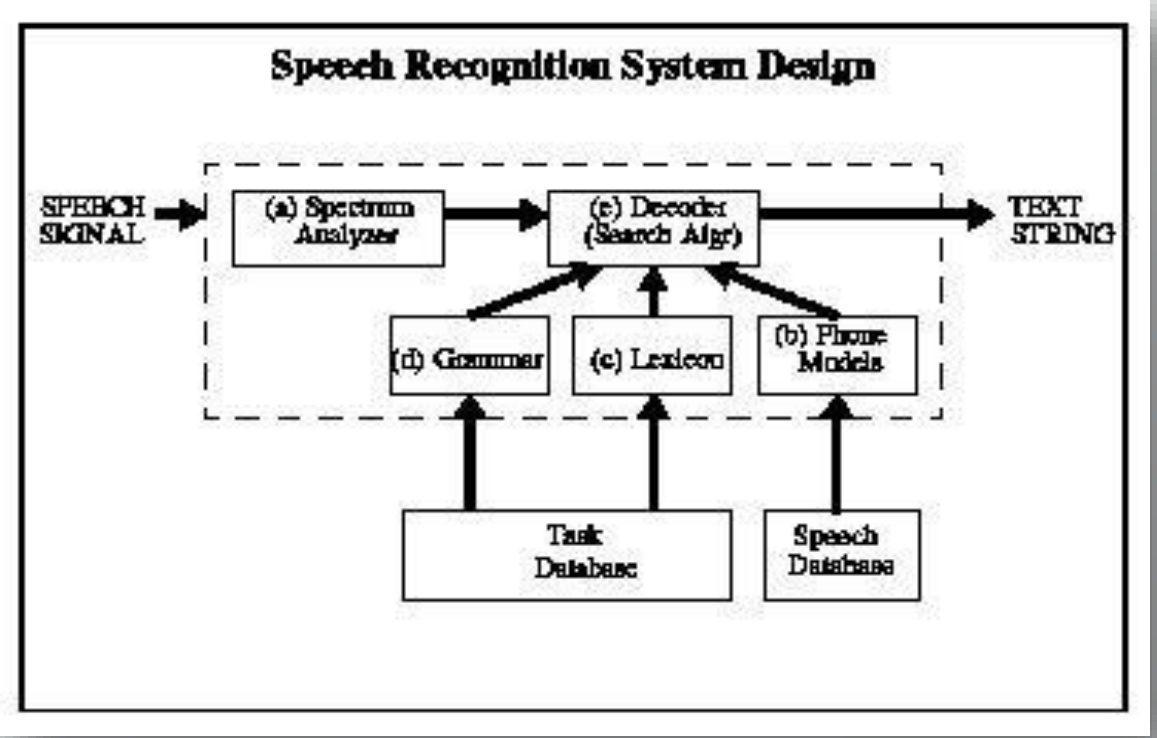
Note: You should use "Individual Title and Content" Slide layout to add the details

Gannt Chat

[redacted]	dur.	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13
	in days													
[redacted]	1													
[redacted]	1													
[redacted]	7-8													
[redacted]	1													
[redacted]	2-3													
[redacted]	1													
[redacted]	1													
[redacted]	1													
[redacted]	5-6													
[redacted]	1													
[redacted]	2-3													
[redacted]	1													
[redacted]	3-4													
[redacted]	3-4													
[redacted]	1-2													
[redacted]	1													
[redacted]	2-3													
[redacted]	1													
[redacted]	2-3													
[redacted]	1													
[redacted]	1-2													
[redacted]	1													

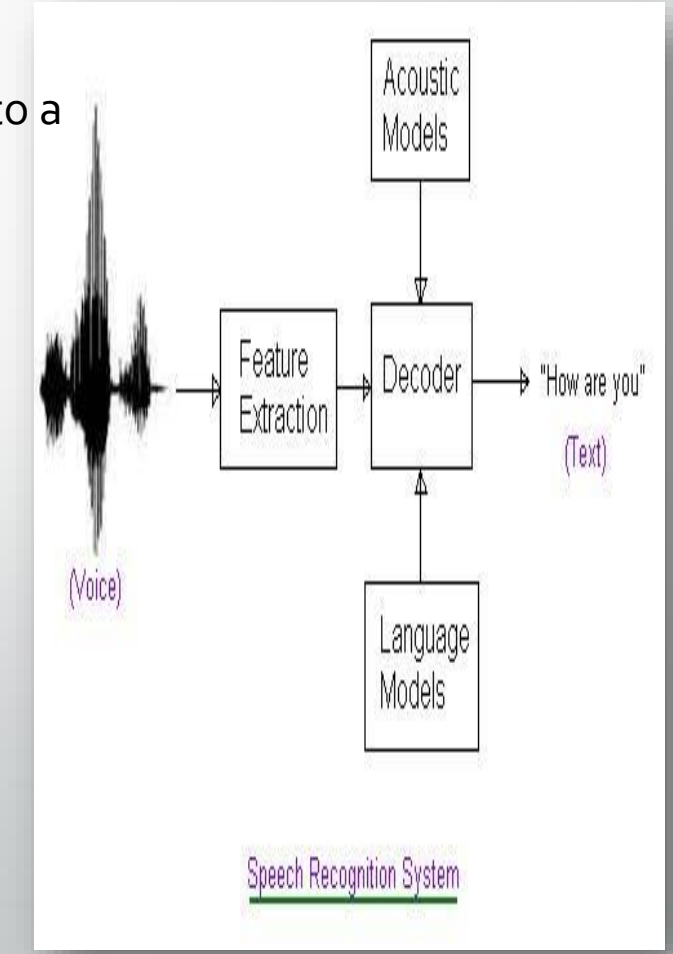
Individual System Diagram





Methodology

- This can be viewed as an inverse operation for speech synthesis system. The kids' voices will be input into the system.
- The Speech recognition unit should be the first to get the input voice and convert it to a text transcript for Natural language processing unit input.
- System should be able to get the voice from the user in a trained language.
- Digital sampling of the input speech in a trained language.
- spectral analysis of digitized speech input recognize words and utterances
- convert speech into text and store as text transcripts.



Technology

- We create web based application using by Rasa framework.

Software Interfaces

- Node JS
- Python with Anaconda navigator distribution
- Windows 10 Operating system
- NPM for dependency management system
- Tensor-flow library
- Visual Studio Code

Hardware Interfaces

- 32-bit or 64-bit(x64) Dual core
- 2.4 GHz or faster processor
- 1 GB RAM
- Web browser
- High quality microphone
- Windows 10,8 or 7

System Interfaces

- Node JS REST API
- TensorFlow based machine learning prediction API

Algorithms

- Speech to text(STT)

Work Breakdown Structure - WBS

Speech Recognition Component				
Initial Phase	**Planning Phase**	**Implementation Phase**	**Testing Phase**	**Deployment Phase**
Feasibility study	Speech enhancement	Concatenate Speech	Unit testing	Product delivery
Charter submission	Speech recognition	Convert the data to text	Integration testing	Maintenance
Charter approval	Text analysis	Prosodic phrasing		
Proposal submission				
Proposal approval				

Supportive informatio

This section MUST inc

Note: You should use "Individual Title and Content" Slide layout to add the details

Budge

Item	Price(Rs.)
Backups	1000.00
Text	500.00
Graphics	500.00
interface Design	700.00
Domain Name	7000.00
Website	500.00
Programming	800.00
Other	700.00
Hosting	3000.00
Marketing	1500.00
Total cost	16,200.00

References

[1] Healthline. (2018). 10 Things That Happen When You Sit Down All Day. [online] Available at: https://www.healthline.com/health/workplace-health/things-thathappenwhen-you-sit-down-all-day#4 [Accessed 18 Feb. 2018].

[2] Adams, D., Allison, C., Adams, D. and Allison, C. (2018). Sit up straight: Best smart posture trainers to save your back. [online] Ware able. Available at: https://www.wareable.com/wearable-tech/the-best-wearables-for-improving-your-posture [Accessed 20 Feb. 2018].

[3] J. A. Healey and R. W. Picard, "Detecting Stress During Real-World Driving Tasks Using Physiological Sensors."

[4] A. W. . Black, H. Zen, and K. . Tokuda, "Statistical parametric speech synthesis," Proc.\ ICASSP 2007, pp. 1229–1232, 2007 [5] Heart.org. (2018). Stress and Heart Health. [online] Available at:

[5]http://www.heart.org/HEARTORG/HealthyLiving/StressManagement/HowDoesStressAf fectYou/Stress-and-Heart-Health_UCM_437370_Article.jsp#.WrpZKi5ubDc%20nzc [Accessed 14 Mar. 2018].

[6] A. Hannun et al., "Deep Speech: Scaling up end-to-end speech recognition," Dec. 2014. S. Furugori, N. Yoshizawa, and C. Iname, "Measurement of Driver ' s Fatigue Based on Driver ' s Postural Change," pp. 264–269, 2003. [

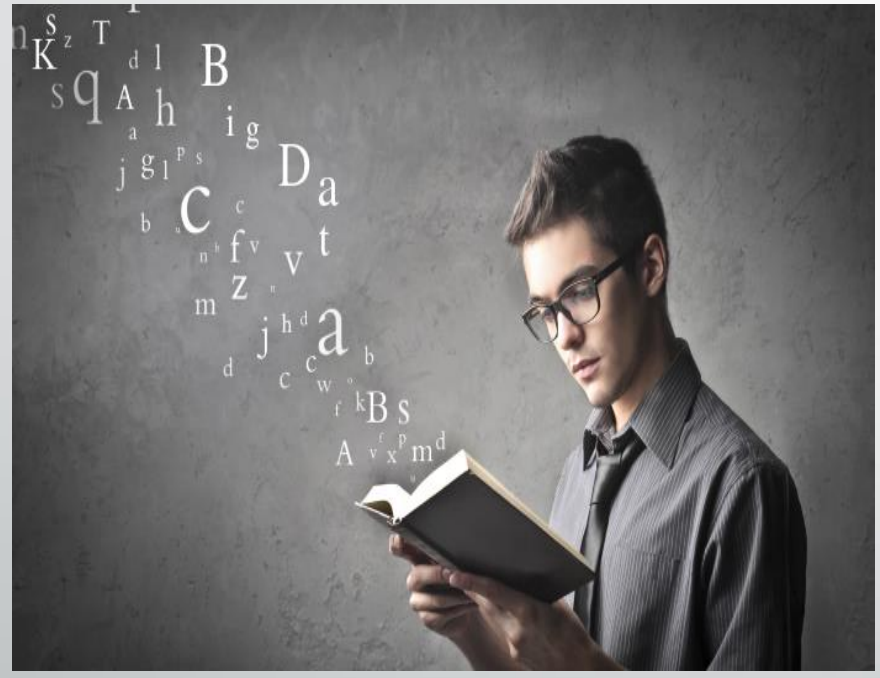
Thank You

IT18081794 | HERATH H.M.D.N

BSc (Hons) in Information Technology Specializing in Information Technology

Introduction

- What is Natural Language Understanding(NLU)?



Background

- What is Natural Language Understanding(NLU)?

Research Gap

- What are existing NLU tools? [1]







Research Gap

- Existing Sinhala NLU tools:
  - Sinling - A language processing tool for Sinhalese[2]
  - Sinhala-news-analysis tool[3]
  - FlaskSpellChecker tool[4]

- Existing Sinhala datasets:
  - Sinmin text corpus[5]
  - SiClaEn news corpus[6]
  - Sinhala PoS tagged data set [7]

Research Question

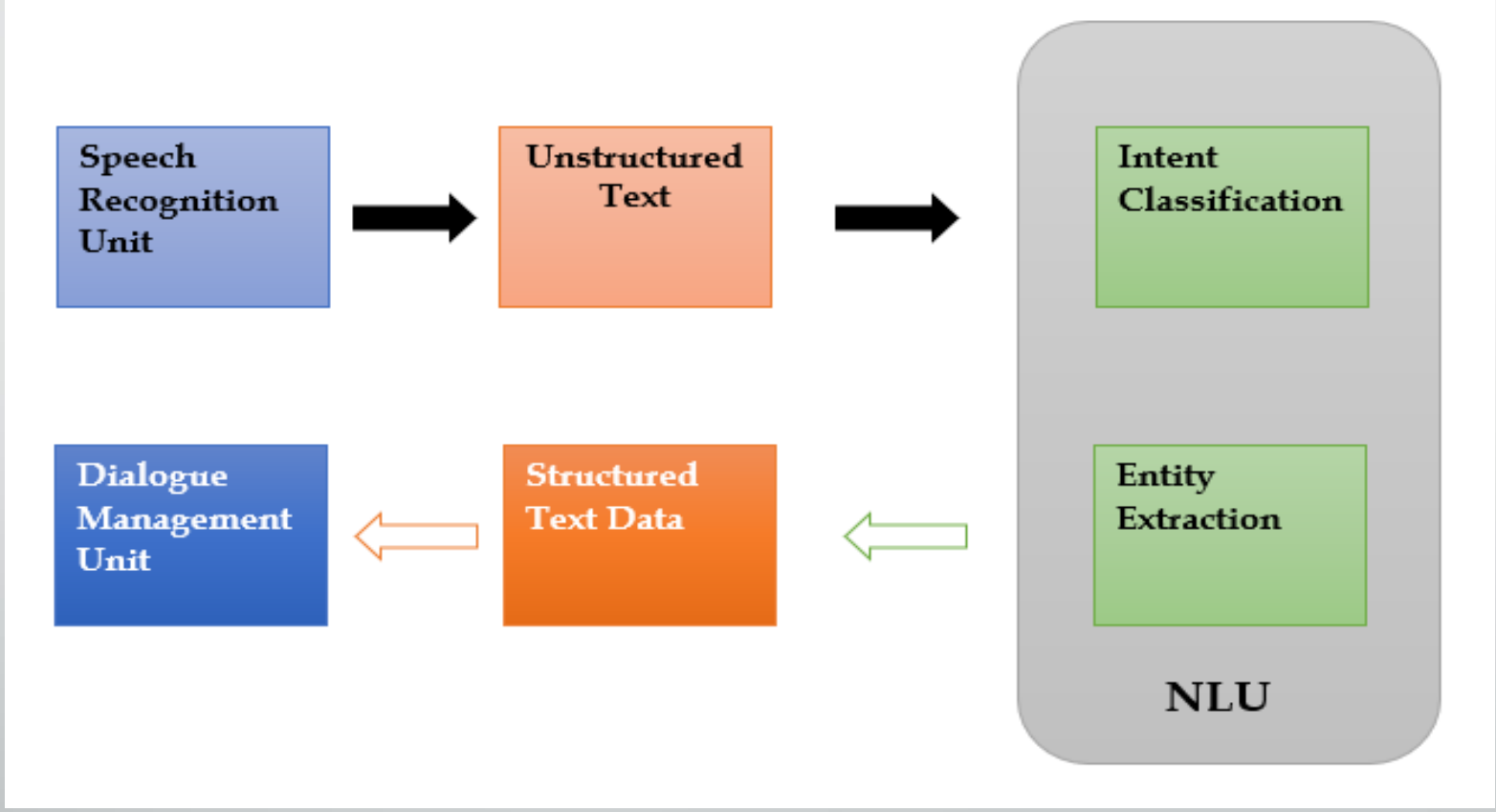
- Lack of customized MLU tools with Sinhala language support in healthcare industry to use as a component to develop a Machine Learning based automated autism screening tool

- Lack of Sinhala corpora to customize existing MLU tools

Specific Objectives

- **Develop a customized MLU tool with Sinhala language support as a component of Machine Learning based automated autism screening tool**
- Support both English and Sinhala languages
- Reduce or eliminate error-prone, inefficient human intervention
- Efficient and robust performance
- Increase availability
- Simultaneous user access
- Cost effectiveness
- Increase overall quality and the productivity of the service

Individual System Diagram



Technology

- Why RASA NLU?

*

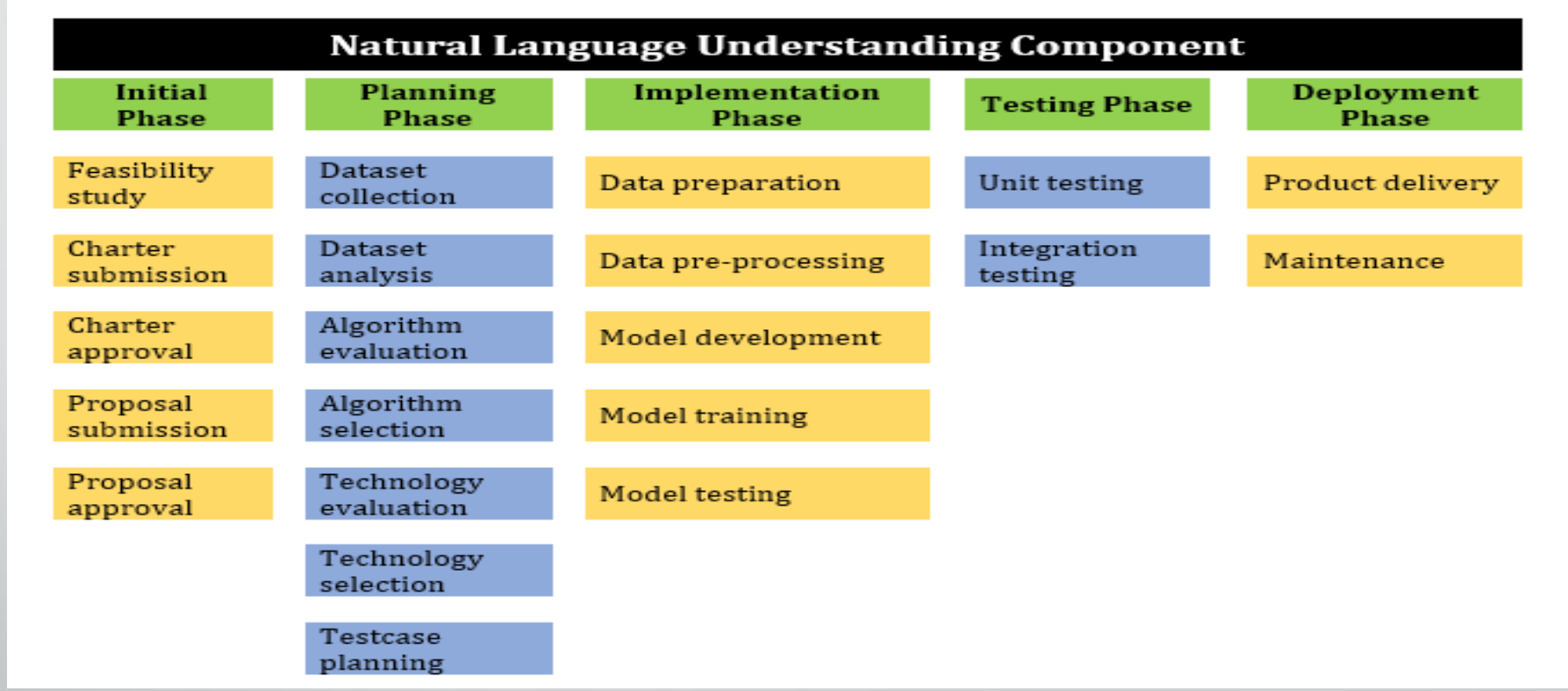
  - Supervised learning model
  - Customizability with other languages
  - Ensures the privacy of datasets
  - Ability to plug in pre-trained models for unique datasets
  - Ability to handle multiple intents in a single message
  - Out-of-the-box model testing capabilities to be more accurate over time
  - Rasa stack supports with Git for version control

Requirements

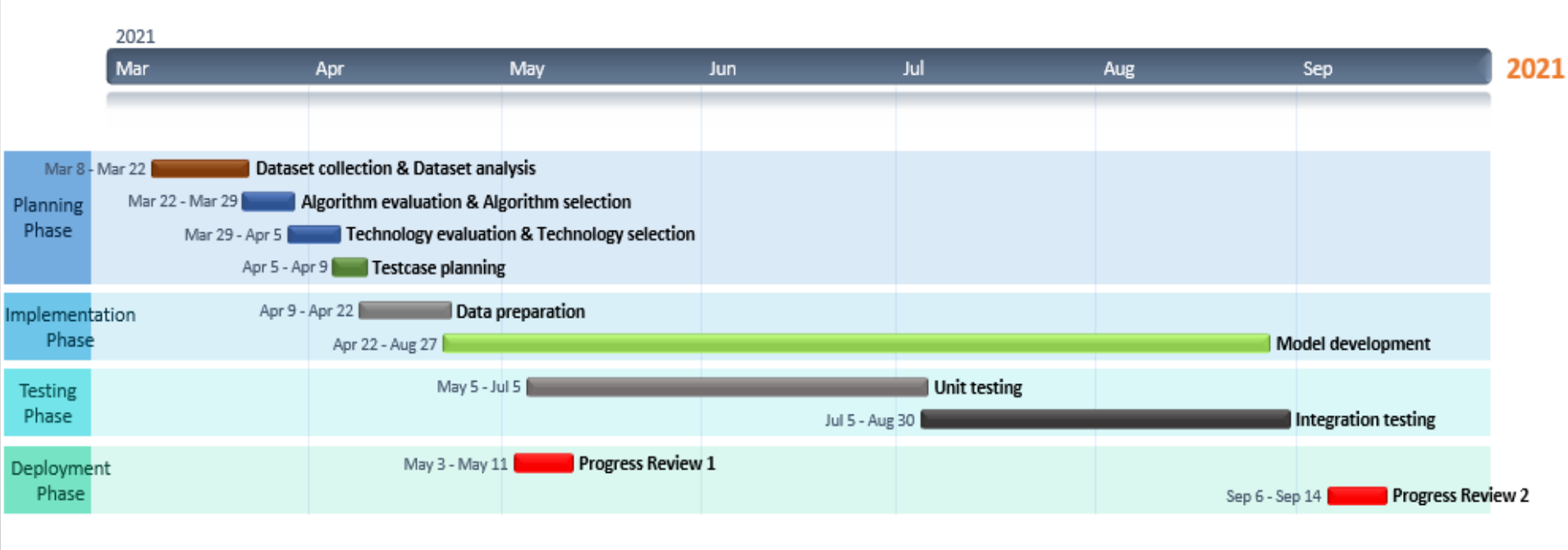
- **Hardware Requirements**
  - 32-bit or 64-bit (x64) Dual-core or above
  - 2.4GHz or faster processor
  - 1 GB or above RAM
  - Chrome web browser
  - High quality microphone

- **Software Requirements**
  - Rasa NLU
  - Windows 10, 8 or 7 Operating System
  - Visual Studio Code
  - Node JS
  - NPM for dependency management
  - TensorFlow library
  - Python with Anaconda navigator distribution

Work Breakdown Structure



Gantt Chart


2021
Mar
Apr
May
Jun
Jul
Aug
Sep
2021
Planning Phase
Mar 8 - Mar 22
Dataset collection & Dataset analysis
Mar 22 - Mar 29
Algorithm evaluation & Algorithm selection
Mar 29 - Apr 5
Technology evaluation & Technology selection
Apr 5 - Apr 9
Testcase planning
Implementation Phase
Apr 9 - Apr 22
Data preparation
Apr 22 - Aug 27
Model development
Testing Phase
May 5 - Jul 5
Unit testing
Jul 5 - Aug 30
Integration testing
Deployment Phase
May 3 - May 11
Progress Review 1
Sep 6 - Sep 14
Progress Review 2

Commercialization

- Innovativeness
- Rapidly growing technology
- Ease of customizability
- Ease of use
- Ease of learn
- Cost efficiency

References

1. https://stackshare.io/rasa-nlu/alternatives
2. https://www.researchgate.net/publication/333769052_A_Rulebased_Lemmatizing_Approach_for_Sinhala_Language
3. https://github.com/rksk/sinhala-news-analysis
4. https://github.com/Tharushashehan/FlaskSpellChecker
5. https://osf.io/a5quv/
6. https://osf.io/tdb84/
7. https://dl.fbaipublicfiles.com/fasttext/vectors-crawl/cc.si.300.vec.gz


THANK
YOU!

IT16090804 | Gunawardhana M. D. R. T.

BSc (Hons) in Information Technology Specializing in Information Technology

SLIIT
FACULTY OF COMPUTING

Dialogue Management Unit

Introduction

- ASD.AI is developed as an automation platform consist of intelligent artificial agents known as "Voice Bots" to automate the ASD screening process of kids of age group 6 months to 4 years who are in early language development age by having a dialogue with them with the ability to handle operations without human intervention. The dialogue management component of the platform does the operation of actions and response generation.
- The dialogue management unit focuses on dialogue generation to keep the ongoing conversation and manage the state of the dialogue. Extracted entities and actions from the natural language understanding phase will act as input to the dialogue management process which then will be processed by the unit with the help of an interpreter, tracker and policy manager.

Background/Research Gap

- A significant amount of research has been carried out in the research domains like Speech Recognition, Natural Language Processing, Conversational Artificial Intelligence and Speech Synthesis which are related to the proposed solution.
- Related to Dialogue Management different approaches have been taken by researchers to achieve the end goal of task completion with the majority focusing on the English Language. Some researches focus on creating an initial knowledge base to map conversation based on entities and actions. In those systems, the output will be generated by mapping the input source content into knowledge base entities and actions. These types of researches have been improved by adding the ability to manage the state of the current conversation thus converting old stateless dialogue management into stateful dialogue management. The advancement of GPU processing and machine learning allowed dialogue management researches to focus on a deep learning-based neural network approach. Recent researches in this field were mostly carried out on this approach. Sinhala Language support issue was still prominent in these research areas too.
- But the proposed platform will mainly focus on providing Sinhala Language support in Conversational Artificial Intelligence. The platform will be a standalone solution that can be installed locally with the ability to customize according to the required scenario. Also, the machine learning algorithms will be trained using existing data to create a domain-specific representation rather than a generic approach followed by most other platforms.

Research Question

- Sinhala is the native language of the Sinhalese people who make up the largest ethnic group of Sri Lanka. The language belongs to the globe-spanning language tree, Indo-European. However, due to poverty in both linguistic and economic capital, Sinhala, in the perspective of Conversational AI tools and research, remains a resource-poor language that has neither the economic drive its cousin English has nor the sheer push of the law of numbers a language such as Chinese has. A number of research groups from Sri Lanka has noticed this dearth and the resultant dire need for proper tools and research for Sinhala natural language processing. However, due to various reasons, these attempts seem to lack coordination and awareness of each other.
- Researches have found that ASD can sometimes be detected at 18 months or younger. By age 2, a diagnosis by an experienced professional can be considered very reliable. However, many children do not receive a final diagnosis until they are much older. This delay means that children with ASD might not get the help they need. The earlier an ASD is diagnosed, the sooner treatment services can begin.

Specific and Sub Objectives

- To manage ongoing conversation dialogues with the aid of a machine learning algorithm
- To train based on previous conversation data
- To perform actions by interacting with an external system via API, query etc.
- To add external system interaction to the conversation
- To add new conversations to the system with sample conversation to be used by bots in their conversations (entity and intent management)
- To suggest actions and context about ongoing conversation to human agent

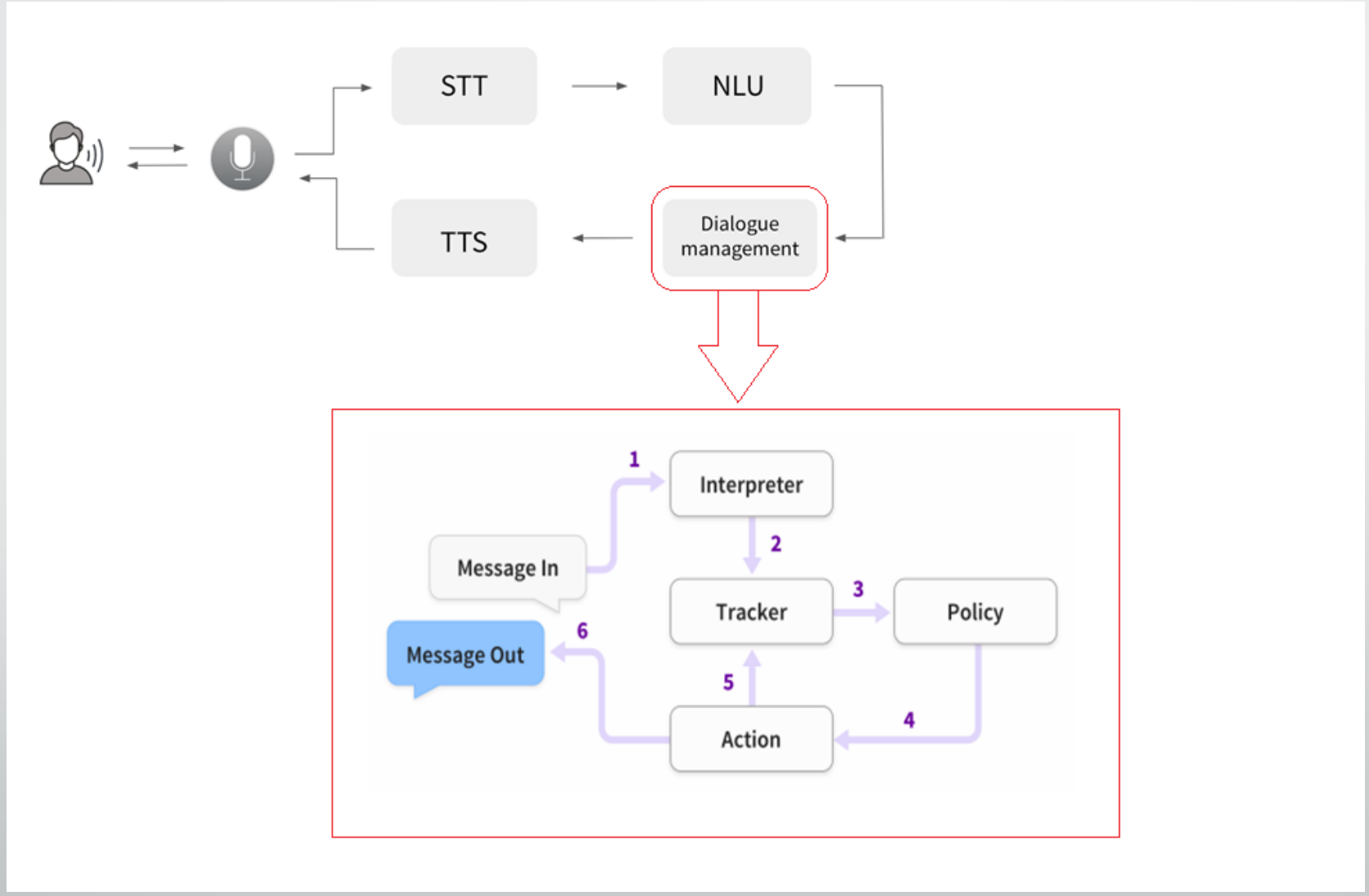
Methodology

- The proposed solution will be based on the existing researches found in the key areas of the platform such as Speech Recognition, Natural Language Processing, Conversational Artificial Intelligence and Speech Synthesis with unique capability of Sinhala Language support and a being standalone decoupled solution.
- The solution will heavily depend on machine learning algorithms to achieve human level intelligence in decision making, dialogue generation and to take actions that maximize its chance of successfully achieving the end goal of customer satisfaction in deployed business domain.
- The processed data from natural language processing unit will be passed to dialogue management unit. The dialogue management unit which is responsible for generating responses for user queries with the end goal of task completion will be developed considering different implementations proposed by the recent researches for high accuracy and speed.
- The dialogue management engine architecture will closely follow the Rasa architecture.

Methodology

- The main purpose of using the above architecture is its ability to support machine correction where users can response whether the action predicted by the engine is correct or wrong depending on the scenario.
- These functionalities allow the platform to suggest actions to human agents in the initial pace of the platform to evaluate itself.
- Additionally, the platform can visualize a graph of training dialogues which can be then be converted as knowledge base for the system domain.
- The dialog management unit proposed with rasa architecture will be modified by applying deep reinforcement learning with ability to generate utterances that optimize future re- ward, successfully capturing global properties of a good conversation. This modification allows more diverse, interactive responses that foster a more sustained conversation

System Diagram



Technologies, Techniques, Algorithms to be Used

System Interfaces

- Node JS REST API
- TensorFlow based machine learning prediction API

Hardware Interfaces

- 32-bit or 64-bit (x64) Dual-core 2.4GHz or faster processor
- 1 GB RAM or above
- Chrome web browser
- High quality microphone
- Windows 10, 8 or 7

Software Interfaces

- Windows 10 Operating System
- Visual Studio Code
- Node JS
- NPM for dependency management
- TensorFlow library
- Python with Anaconda navigator distribution

Communication Interfaces

- "ASD.AI" web application will communicate with the server using LAN connection or Wi-Fi connection depending on the scenario.
- Might need to connect to internet using HTTP protocol if the server is hosted on a cloud environment.

Memory Constraints

- 8 GB RAM and 1 TB HDD space in server machine (Server machine is expected use less than above memory amount)
- GTX 1050 4GB or above GPU in server machine (Higher end GPU can result in faster performance in machine learning algorithm predictions for real-time usage)

System, Personal, and Software Specification Requirements

Hardware Requirements

- The proposed platform depends heavily on machine learning to achieve high accuracy conversational predictions. To achieve a high accuracy the underlying machine learning model must be trained using large amount of existing conversation data. Practically training large amount of data is time consuming on a standard hardware-based computer with traditional CPUs. GPU based training is identified as the solution to training large amount of data. Machine learning model training server with 8GB RAM, 1TB of HDD space and GTX 1050 4GB or above is identified as the minimum hardware requirements for the server machine for real-time inference of the machine learning model. The server machine should also consist of a reliable connection to internet via Wi-Fi or LAN connection to dependency management and remote server accessibility

Software Requirements

- The proposed platform's web application will be developed using React.js for the frontend development and Node.js for the backend development. The machine learning based prediction server will be developed using TensorFlow framework with GPU based training and inference.

System, Personal, and Software Specification Requirements

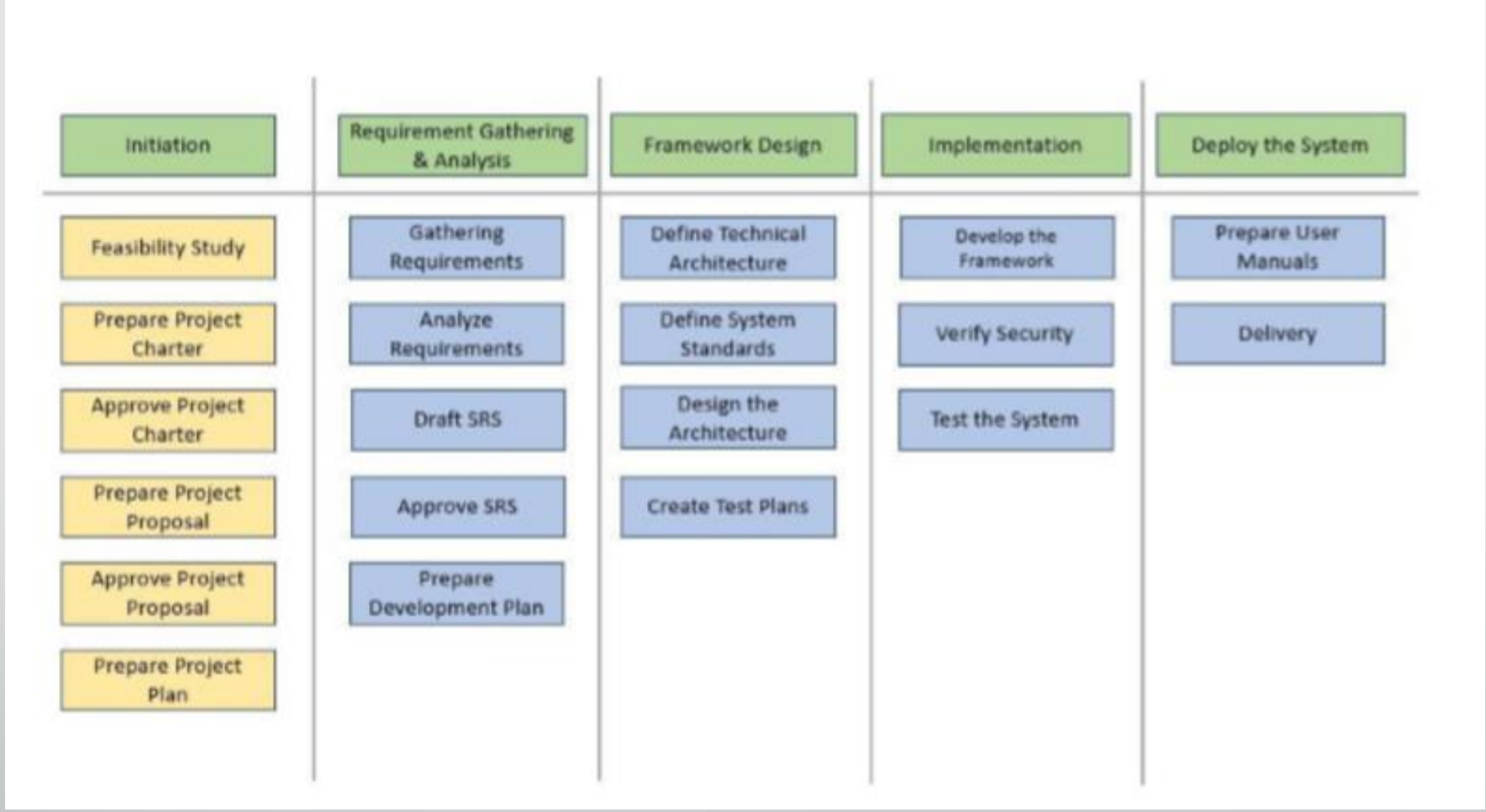
Design Requirements

- This application must have the capability to run in real-time.
- The web application should be designed to be simple and detailed as possible to enhance productivity.
- Machine learning models' predictions must achieve higher level of accuracy.
- The proposed platform should support real-time conversion of speech to text and text to speech by minimum amount of lag.

Site Adaptation Requirements

- The proposed platform's reliability will depend on the quality of voice data input into the system.
- The proposed platform's performance will depend on the hardware of the server computer meeting at least the minimum specified requirements.
- The web application should be developed in a simple, understandable and easy to use manner to increase user friendliness.
- Initially the system should support feedback process by human agents for suggested actions and improve the machine learning model based on these feedback.

Work Breakdown Structure - WBS



Commercialization

- The Dialogue management solution proposed will be highly useful as it supports Sinhala and English languages and manages conversations in a stateful manner. With the rapid increase in the number of kids being affected with ASD, the void to be filled through a tool based on an IT platform is becoming a growing need.
- Moreover, with the rapid advancement of technology the solution proposed will directly address the need for a screening method that is inexpensive and effective. It will facilitate report generation in order to allow a patients physician to monitor the patients progress regularly. The solution will ensure the accuracy of the test results using the algorithms utilized for calculations.
- Commercialization of a tool addressing all of such requirements, which will additionally be beneficial for users outside of the targeted domain can be considered as a straightforward yet rewarding, novel venture.

References

- [1] J. D. Williams, K. Asadi, and G. Zweig, "Hybrid Code Networks: practical and efficient end-to-end dialog control with supervised and reinforcement learning," Feb. 2017.
- [2] J. Li, W. Monroe, A. Ritter, M. Galley, J. Gao, and D. Jurafsky, "Deep Reinforcement Learning for Dialogue Generation," Jun. 2016.
- [3] V. Ilievski, C. Musat, A. Hossmann, and M. Baeriswyl, "Goal-Oriented Chatbot Dialog Management Bootstrapping with Transfer Learning," Feb. 2018.
- [4] N. Webb, "Rule-Based Dialogue Management Systems," 2001.
- [5] B. Peng et al., "Composite Task-Completion Dialogue Policy Learning via Hierarchical Deep Reinforcement Learning," Apr. 2017.

4

SPEECH SYNTHESIS

Information Technology

IT16061880 SAMPATH G.A.D.M 2021-006

SLIIT
FACULTY OF COMPUTING

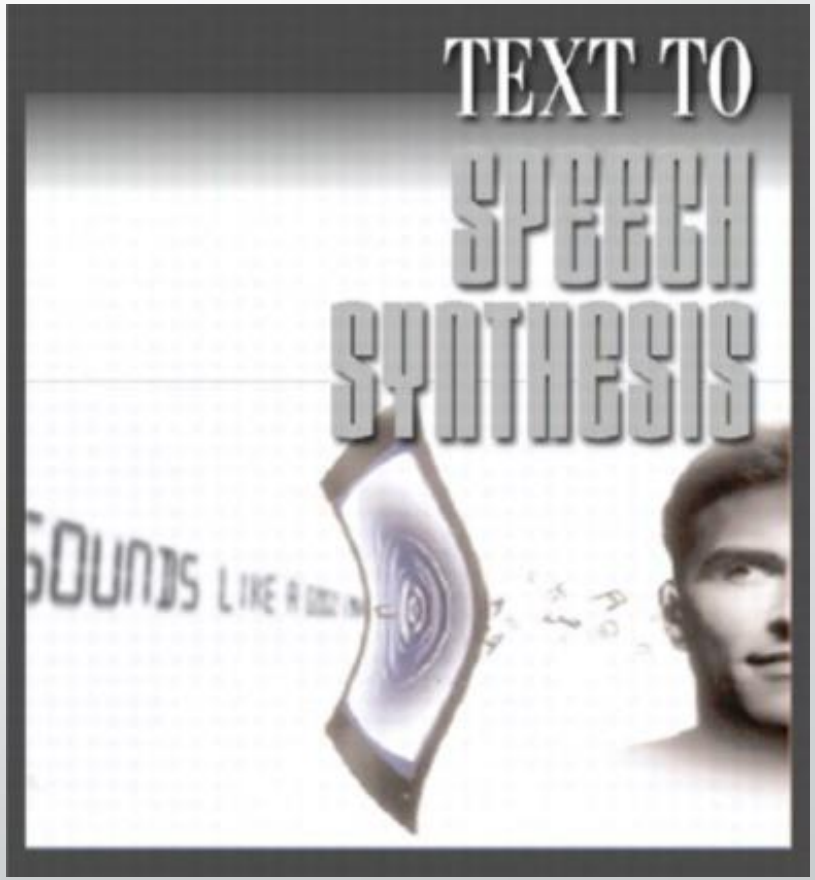
Introduction

- **A state-of-the-art neural speech synthesis system.**

The system will be implemented based on the implementation of Deep Voice 3 and Wave NET with support for English and Sinhalese languages.

The recurrent neural network will be trained using a module containing an encoder, decoder, and transformer. The encoder converts the text functions to an internal learned representation.

The decoder decodes the memorized performance, while the transformer creates post-processed audio to make the voice more human.



Research Problem

- Finding correct intonation, stress and duration from written text.
- When pronouncing the written text, there should be a correct rhythm, melody, and emphasis of the speech.
- Timing at sentence level or grouping of words into phrases correctly is difficult.
- Some words which are called as homographs, cause the most difficult problems in text-to-speech systems.

Research Objectives

Main Objective

- **MoA state-of-the-art neural speech synthesis system.**

Specific objectives

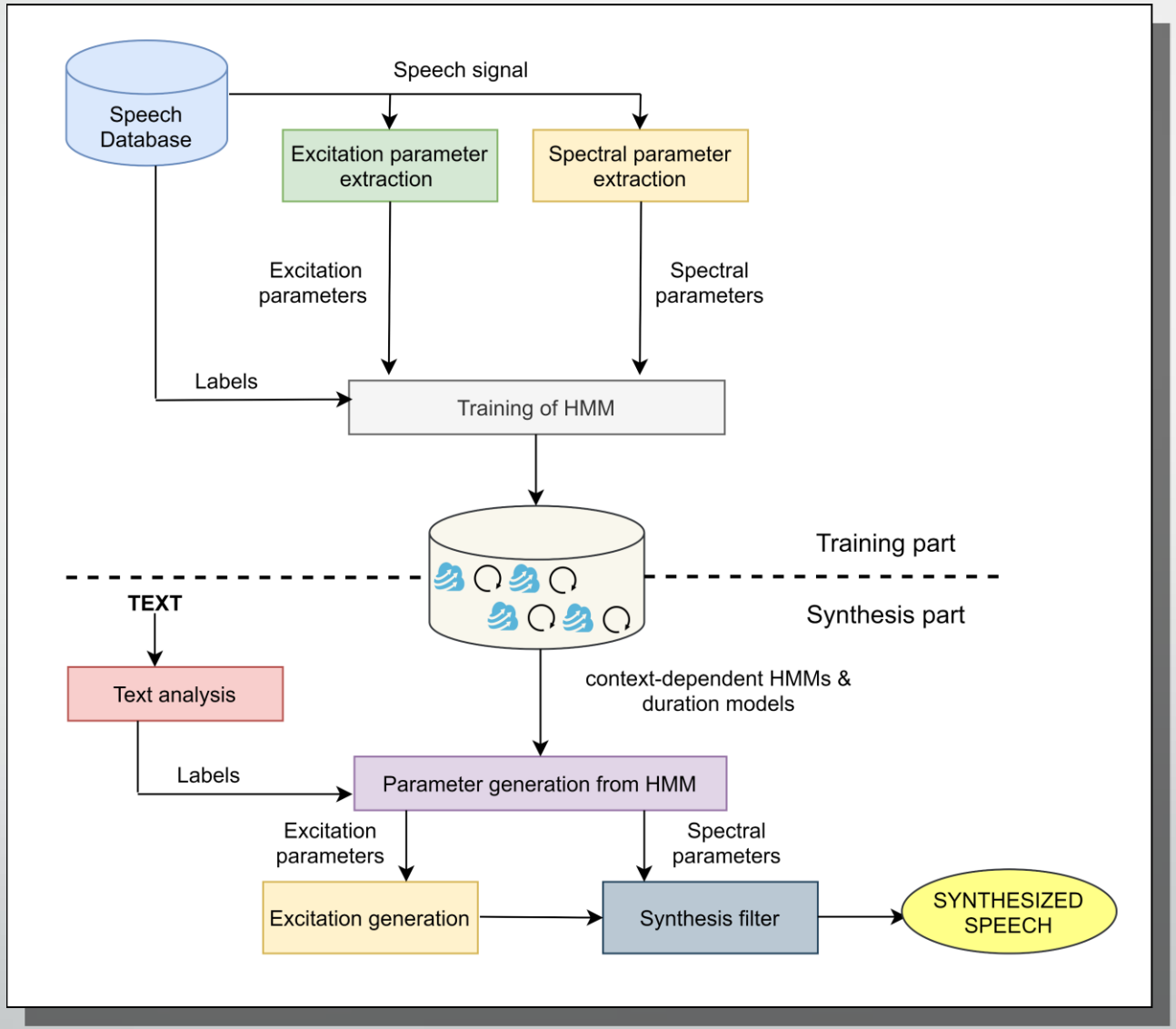
- Do the text pre-processing task to overcome the problems discussed in research problem part.
- Find correct pronunciation for different contexts in the text.
- Find correct intonation, stress, and duration from written text.
- Implement a method to pronounce the given text with proper rhythm, melody.

Research Gap

- The issue of supporting the Sinhalese language is still relevant .
- Types of speech synthesis methods to obtain better text to speech is presented.
- This research part design and implementation of Sinhala and English Text to Speech (TTS) system from the very raw level without using any third-party speech synthesis tool.

Methodology

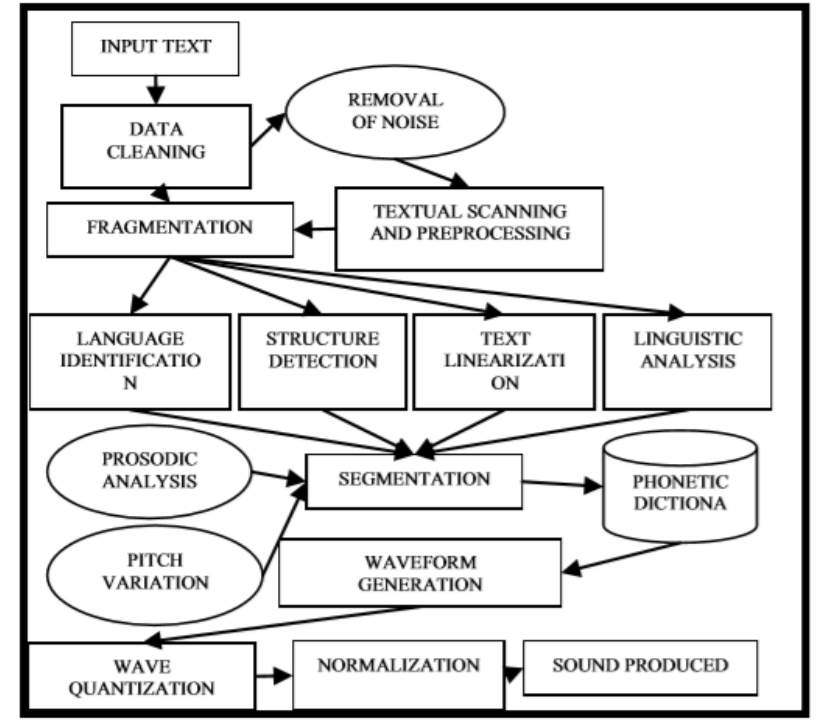
System Overview Diagram



Methodology

This can be viewed as an inverse operation for speech recognition.

- A given word sequence is converted into a context dependent label sequence, and then the utterance HMM is constructed by concatenating the context dependent HMMs according to the label sequence.
- The speech parameter generation algorithm generates the sequences of spectral and excitation parameters from the utterance HMM.
- Although there are several variants of the speech parameter generation algorithm, the Case 1 algorithm in has typically been used
- A speech waveform is synthesized from the generated spectral and excitation parameters using excitation generation and a speech synthesis filter.



TECHNOLOGY

- We create web based application using by Rasa framework.

Software Requirements

- Windows 10 Operating system
- visual studio code
- Node JS
- NPM for dependency management system
- Tensor-flow library
- Python with Anaconda navigator distribution

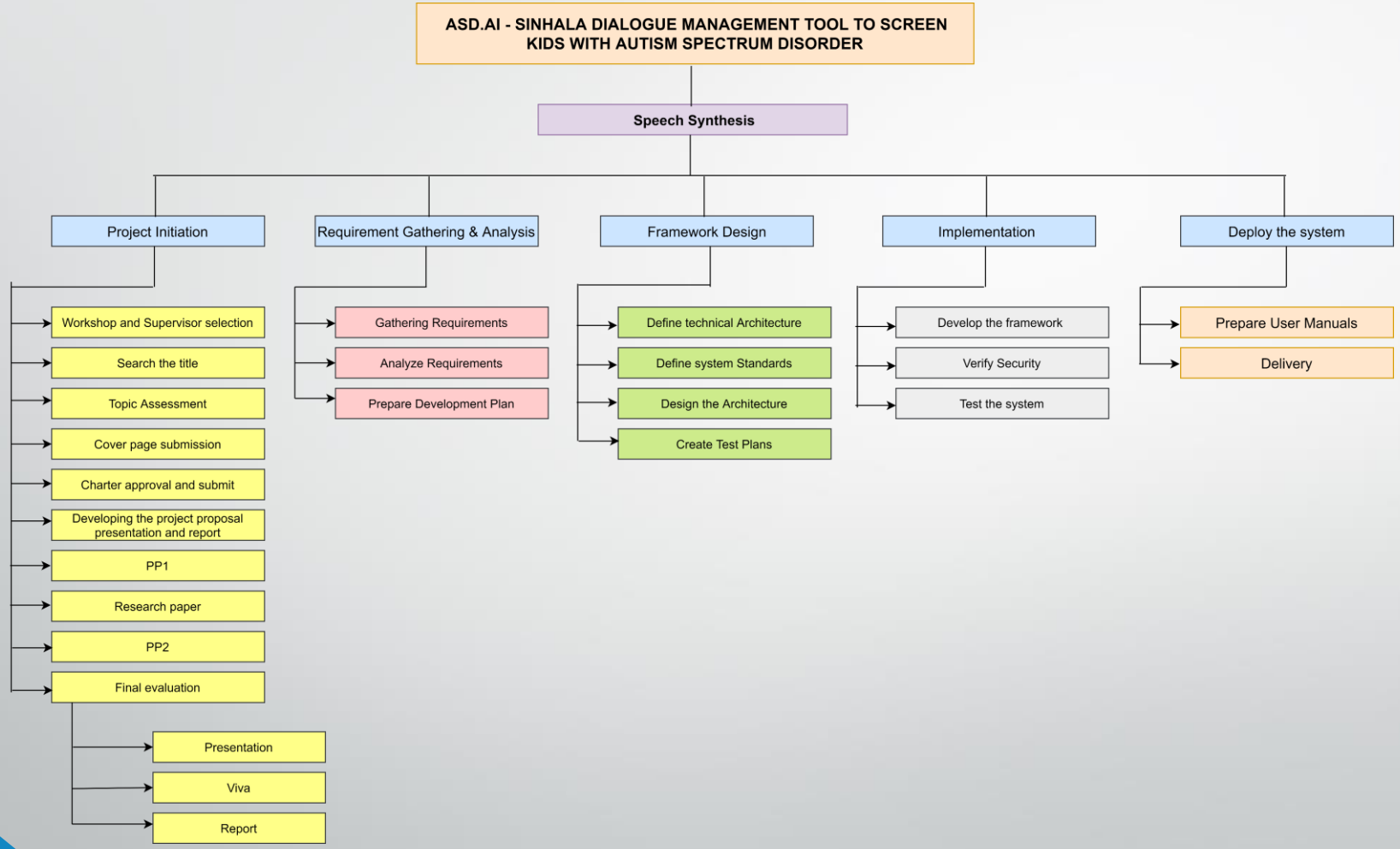
Hardware Requirements

- 32-bit or 64-bit(x64) Dual core
- 2.4 GHz or faster processor
- 1 GB RAM
- Web browser
- High quality microphone
- Windows 10,8 or 7

BUDGET

Task	Cost (Rs :)
Domain name	3000
Hosting	4000
Backups	1000
Mobile app strategy	600
Logo/branding	100
Content creation	
Text	400
Graphics	500
Photography	0
Interface Design	800
Programming	700
Testing	500
Other	1500
Maintenance	500
Marketing	1000
Total cost	14600

WORK BREAKDOWN



REFERENCES

[1] G. A. Rachel, S. L. Christina, V. S. Solomi, B. Ramani, P. Vijayalakshmi, and T. Nagarajan, "Development and analysis of various phone-sized unit-based speech synthesizers," 2013 Int. Conf. Orient. COCOSDA Held Jointly with 2013 Conf. Asian Spok. Lang. Res. Eval. O-COCOSDA/CASLRE 2013, 2013.

[2] S. Lukose and S. S. Upadhya, "Text to speech synthesizer-formant synthesis," 2017 Int. Conf. Nascent Technol. Eng. ICNTE 2017 - Proc., pp. 1–4, 2017.

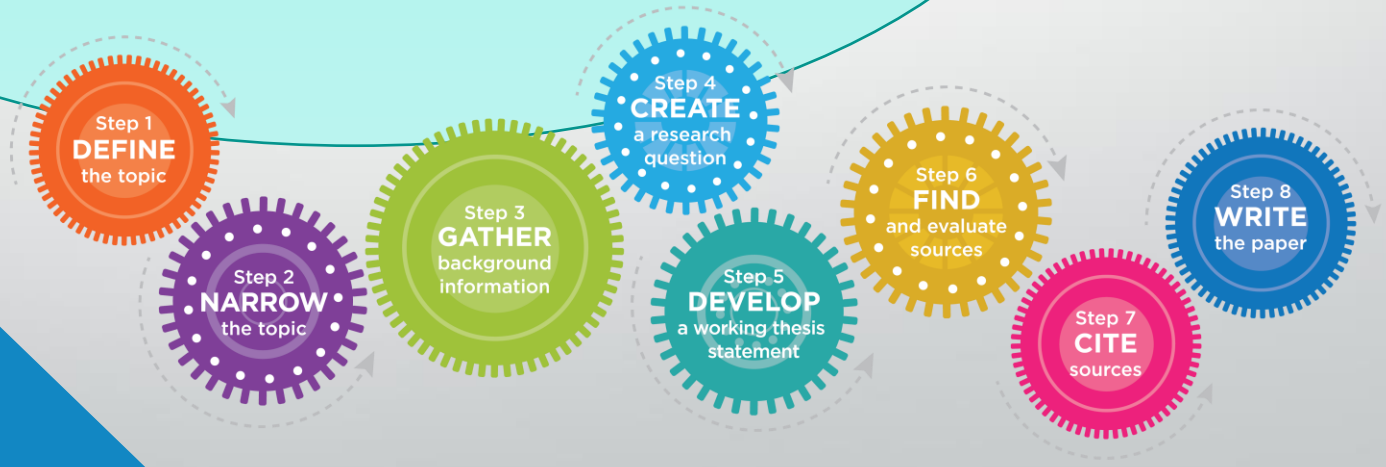
[3] S. Rashmi, M. Hanumanthappa, and N. M. Jyothi, "Text-to-Speech translation using Support Vector Machine, an approach to find a potential path for human-computer speech synthesizer," Proc. 2016 IEEE Int. Conf. Wirel. Commun. Signal Process.
Networking, WiSPNET 2016, pp. 1311–1315, 2016.

[4] M. Vasek, G. Rozinaj, and R. Rybarova, "Letter-To-Sound Conversation for Speech Synthesizer," pp. 5–8, 2016.

[5] B. Ramani, A. J. M. P, P. Vijayalakshmi, and T. Nagarajan, "Voice Conversion-Based Multilingual to Polyglot Speech Synthesizer for Indian Languages," 2013.

[6] S. Kannojia, "A Text to Speech synthesizer using acoustic unit-based concatenation for any Indian Language of Devnagari Script," 2016.

End !



SLIIT
FACULTY OF COMPUTING

IT16061880 / SAMPATH G.A.D.M / 2021-006