DEAF'S COMPANION: A SMART BRACELET FOR DEAF PARENTS

A PROJECT REPORT

submitted by

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in partial fullfilment of the requirements for the award of the degree

of

Master of Computer Applications

Department of Computer Applications

College of Engineering

Trivandrum-695016

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Declaration

I undersigned hereby declare that the project report titled **"Deaf's Companion: A Smart Bracelet for Deaf Parents"** submitted for partial fulfillment of the requirements for the award of degree of Master of Computer Applications of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of **Prof. Minu R Nath**, Associate Professor. This submission represents my ideas in my words and where ideas or words of others have been included. I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity as directed in the ethics policy of the college and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the Institute and/or University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title.

Place : Trivandrum **Najiya Nazrin P N**

Date : 11/07/2022

DEPARTMENT OF COMPUTER APPLICATIONS

COLLEGE OF ENGINEERING
TRIVANDRUM

CERTIFICATE

This is to certify that the report entitled **Deaf's Companion: A Smart Bracelet for Deaf Parents** submitted by **Najiya Nazrin P N** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree of Master of Computer Applications is a bonafide record of the project work carried out by her under my guidance and supervision. This report in any form has not been submitted to any University or Institute for any purpose.

Internal Supervisor External Supervisor

Head of the Dept

Acknowledgement

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Najiya Nazrin P N

Abstract

The Internet of Things (IoT) and its technologies have had a significant impact on numerous concepts, services, and methods of dealing with and accessing them in this century. If a user using a service has some health problems or difficulties, such as hearing loss or disability, technology can help them execute their everyday responsibilities in the same way that a healthy person, free of any deficiency, would. For example, hearing loss makes it impossible for parents to respond to their children's calls.

In this project I am putting forward an innovative idea for a special bracelet designed with a smart application to solve the difficult problem that is experienced by deaf parents. If the child is a normal kid, the application listens to child's calls by converting the sound into writing and then classifies the type of sound and then sends an alert to their parents by controlling the bracelet. If the child is an infant, then the system detects the sound and notifies the parent by sending alerts to the bracelet as well as to the application. The bracelet is based on the ESP32 controller to vibrate, which enables parents to respond to their children's calls. A prototype of the proposed bracelet has been built and designed the circuit in addition to building the accompanying application. The proposed solution is characterized by its ease of application, development, and effectiveness, in addition to its low cost compared to other existing tools.

Contents

List of Figures

List of Tables

Chapter 1

Introduction

Our society has been greatly impacted by the Internet of Things, particularly in the manner that we deal with the devices and objects that are all connected to the network. Numerous intelligent applications and services in multiple sectors have been made possible by IoT. The goal of the Internet of Things is to make everything around us an intelligent object that can sense, process, and share information using wireless network sensors, RFIDs, and smart applications. In important fields including medicine, education, business, services, energy, the environment, and many others, IoT proved their influence and presence.

People's regular activities are negatively impacted by hearing loss. Deaf people, as a group or culture, might then be viewed as a linguistic minority, and some members of this community may feel misunderstood by those who do not know sign language. Modern technology, however, makes an effort to overcome these challenges by putting various concepts, algorithms, applications, and instruments into practise with the aim of comprehending the deaf's communication mechanisms and language. The situation is more convoluted and could have consequences when it comes to a deaf individual watching over their child. For example, how would a deaf mother be able to identify that their child has cried, is upset, or is in danger?

A few companies have introduced tools that enable parents to regularly watch their children using specific gadgets such as surveillance cameras or noise-sensitive software linked to smartphones. However, these programmes have not effectively addressed the aforementioned issue, particularly for deaf parents.

The system "Deaf's Companion: A Smart Bracelet for Deaf Parents" works by utilising Internet of Things technology to assist deaf parents in responding to their children's calls in real-time by designing a low-cost bracelet that vibrates and displays the speech in the parent's hand when the child calls, and the bracelet will be associated with a mobile application which works to discover these calls. If the child is an infant, the system detects whether the kid is crying or not and notifies the parent by vibrating the bracelet.

Chapter 2

Literature Review

Interacting with deaf peoples are challenging, especially those who don't know sign languages. The benefits of monitoring such an entity are numerous. I gathered information from many publications connected to the Internet of Things and machine learning throughout my literature research because these two technologies are the two technologies of the proposed system.

2.1 Designing a Smart Bracelet based on Arduino for Deaf Parents to Interact with their Children

The major goal of the study was to create a low-cost smart bracelet that allows deaf parents to be notified to their children's calls and respond swiftly by designing a mobile application to answer various calls from children to their parents. Rather than merely monitoring newborns, a new smartphone app was created to respond to regular children's calls. The app allows parents to set up a series of keywords to be monitored, such as "papa," "mama," and so on, as well as the app constantly records the surrounding sounds and then converts the sound into writing using the Google library API TTS, and then compare results with the words saved in the settings section, and if there is a match, the app will alert via Bluetooth to the smart bracelet.

2.2 A Cost Effective IoT-based System for Monitoring Baby Incidents by Deaf Parents

This research proposed a method for parents to learn about their infant's needs by continuously monitoring them via sound or image and alerting the parents. Parents who are unable to hear their children could be notified by wearing a special bracelet. This study adds to prior studies on the design and development of the unique bracelet, as well as some additional features of the application that will allow it to serve a broader group of families.

2.3 IoT based Assistive Device for Deaf, Dumb and Blind People

The application has built by creating a unique design for supporting persons with disabilities. It has separated into three modules in order to improve the user's experience with the device. The device has three modes and a three-way slider to switch between them. The device has separate modules for the blind, deaf, and dumb people respectively intended to make the user feel independent, self-sufficient, and self-reliant. The Raspberry Pi is the device's core component.

Chapter 3

Problem Defnition and Motivation

The proposed system makes use of IoT and Android Application to make deaf parent's interaction more smoother. This objective is further inspired by the deaf community's sense of isolation. Loneliness and sadness are more prevalent among the deaf community, particularly when they are involved in a hearing world. The communication gap between the deaf and the hearing creates significant hurdles that have a dramatic impact on living quality. Examples include a lack of information, a lack of social relationships, and difficulty integrating into society. The motivation behind the project is also the drawbacks of the existing system as well and why wouldn't we make use of IoT to these deaf peoples.

3.1 Existing System

People who want to interact with deaf people uses sign languages. This is the most common method to communicate with people who are differently abled in hearing.

Another existing approach is android speech to text. If parent want to understand what their kids said, on the Android phone or tablet, install Gboard, then open any application that helps us to type, such as Gmail, tap an area to enter the text, touch and hold microphone which is at the top of keypad, then say what you want written when they see "Speak now."

3.1.1 Disadvantages of Existing System

- In the first system, system will fail if the person doesn't know sign language.

- Interaction will be also challenging if the kid is blind, so speech is needed.
- Second system is time consuming since we want to manually open and app and turn the microphone on.
- Both are not feasible in several conditions.

3.2 Proposed System

Proposed system basically have two modules; a module for normal kid and an infant module.

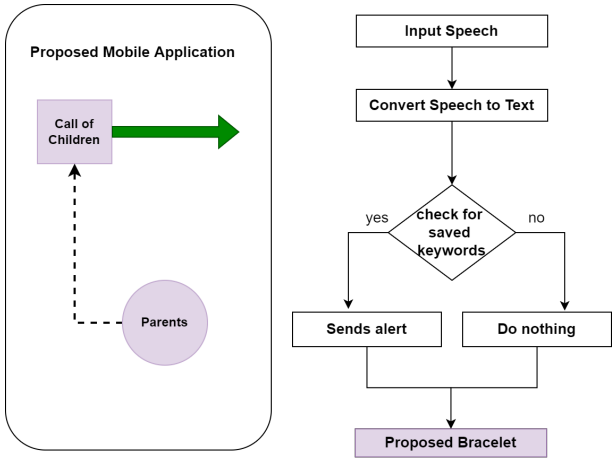

Figure 3.1: Normal Kid Module

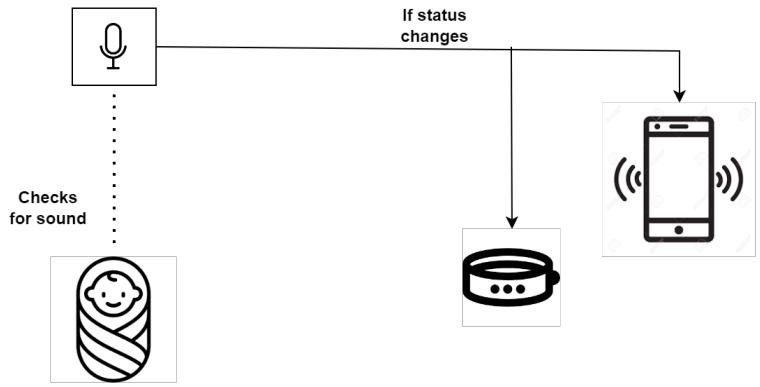

Figure 3.2: Infant Module

If the child is an infant, then the child monitoring module is activated. In this module, the system detects disturbing noises around the infant using a sound sensor embedded with a

microphone, and then sends an alert to the parent via application as well as the bracelet, so if the parent wants to see what besides the kid is happening he/she could monitor with the external camera in a button click.

If the child is a normal kid who can speak, then there will be a set of predefined keywords that could be managed by parents, and with the help of these keywords, the call of the kid is detected. Then the system converts the speech to text, sends an alert via bracelet and the converted speech is displayed both on the bracelet as well as in the application.

3.2.1 Advantages of Proposed System

- There's no need for parents to manually open and close the app to see what kid is saying.
- Through this system parent will feel like other parents as they can understand what their kid said without any third person's help.
- Kid no longer needed to learn sign language to interact with their parent.

Chapter 4

System Analysis

4.1 Feasibility Study

Feasibility Analysis involves different steps such as preparation of system flow chart, enumerating potential candidate systems, describing and identifying the characteristics of candidate systems, and so on. The Aspects of feasibility includes technical feasibility, operational feasibility, financial and economic feasibility, and behavioural feasibility.

4.1.1 Technical Feasibility

A feasibility study's primary purpose is to establish whether building a system is technically, socially, and economically feasible. This is achieved by investing the existing system in the area under consideration and developing suggestions for the future system. A feasibility study has done to acquire the essential information. Training, competence, and common sense are required for data collection. Data was taken and double-checked for accuracy and completeness. Analyzing the data included establishing the system's strengths and weaknesses, as well as identifying the system's components and their interrelationships.

4.1.2 Operational Feasibility

Implementing the system is very easy. The proposed system is efficient and easy to use. Users of the system should be fully aware of the internal behavior of the system so that they do not have any problems operating the system. As a result, the system reduces computer response time and makes it operational viable. The only way to accurately convert a user registration

into a completed software or system is by design. Without software design, you run the risk of creating an unreliable system. The system design provides the procedural functionality required to run the system specified in the feasibility study.

4.1.3 Economical Feasibility

The effectiveness of the system is assessed using economic and financial analysis. The project is technically and operationally feasible.

4.1.4 Behavioural Feasibility

The behavioural feasibility of the system is determined by whether it performed as intended. A feasibility study evaluates a system design's workability, organisational impact, ability to meet user needs, and resource efficiency. A feasibility study is a good starting point when undertaking a complete inquiry.

Chapter 5

System Requirements and Specification

5.1 Hardware Description

5.1.1 ESP32

The ESP32-WROOM-32 is a powerful, generic Micro Controller Unit module integrated with Wi-Fi and dual-mode Bluetooth that can be used for a wide range of applications, from low-power sensor networks to some of the most demanding activities like voice encoding, music streaming, and MP3 decoding. The ESP32 chip has 48 pins with various functionalities.

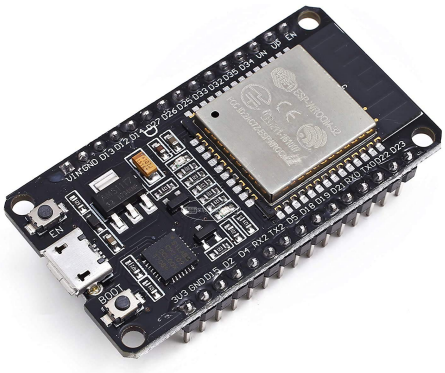

Figure 5.1: ESP-WROOM 32

5.1.2 Micro Vibrator Motor

Used to alert deaf parents by vibrating without sound.

Figure 5.2: Micro Vibrator Motor

5.1.3 0.91 OLED

This is a general purpose OLED display Module having embedded controller with a 0.91inch diagonal and 128x32 pixel resolution that communicates over the I2C interface.

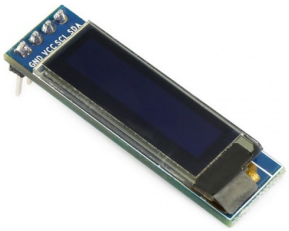

Figure 5.3: 0.91 OLED

5.1.4 Microphone Sound Sensor

As the name implies, the microphone sound sensor detects sound. It measures the intensity of a sound.

Figure 5.4: Microphone Sound Sensor

5.2 Software Description

5.2.1 Android Studio

Android Studio is Google's official integrated development environment (IDE), built on JetBrains' IntelliJ IDEA software and designed exclusively for Android programming. It is accessible for download on Windows, macOS, and Linux-based operating systems, as well as as a subscription-based service. It is the major IDE for native Android application development, replacing the Eclipse Android Development Tools (E-ADT).

5.2.2 Arduino IDE 1.8.19

The Arduino Software (IDE), which is open source, includes a text editor, a message area, a text console, a toolbar with buttons for common functions, and a series of menus makes it simple to create code and upload it to the board. This software is compatible with any Arduino board.

5.2.3 Firebase

Google Firebase is a platform for developing mobile and online applications. Authentication and database management of the android application is done using this.

Figure 5.5: Android Studio

Figure 5.6: Arduino IDE

Figure 5.7: Firebase

5.2.4 Hardware Requirements

- Processor : Intel Core i3
- Storage : 512 GB Hard Disk space
- Memory : 4 GB RAM
- IoT Module : ESP32, Sound sensor, micro vibration Motor, OLED display, male to male jumper wires.
- Mobile Phone Connection : Smart phone with internet

5.2.5 Software Requirements

- Operating System : Linux/Windows
- IDE : Arduino IDE, Android Studio
- Front-end: Java
- Back-end : Firebase
- Web Browser : Firefox/Chrome/Safari/Opera

5.3 Functional Requirements

A functional requirement is a requirement of behaviour between inputs and outputs that specifies a function of a system or its component. Arduino IDE, Android Studio and Firebase are needed for the smooth functioning of the system.

5.4 Non Functional Requirements

5.4.1 Performance Requirements

- Unique ID : Each user who registers has unique id.
- Speed : The alert is sent to the parents quickly.
- Cost Effective : The implementation of proposed system only costs less.
- Accuracy : The system performs well compared to existing systems.
- User Friendly : The system's user interface is very user friendly makes it easy to be used by deaf parents.

5.4.2 Quality Requirements

- Scalability : All functional requirements are met by the system.
- Maintainability : Software components are easily maintainable to get adapted by the changed environment.

Chapter 6

Design And Implementation

6.1 Input Design

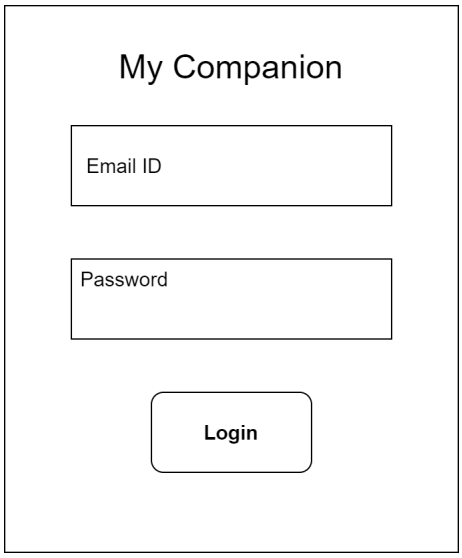

Figure 6.1: Login Page

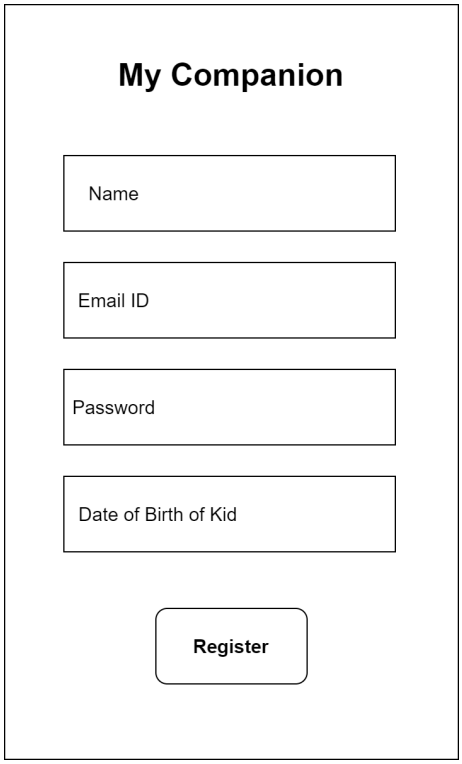

Figure 6.2: Registration Page

6.2 Output Design

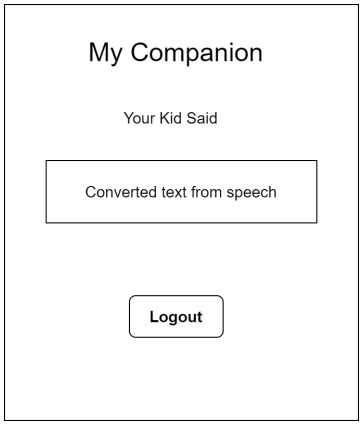

Figure 6.3: Output page displaying converted speech to text

6.3 Architectural Framework

6.3.1 Block Diagram

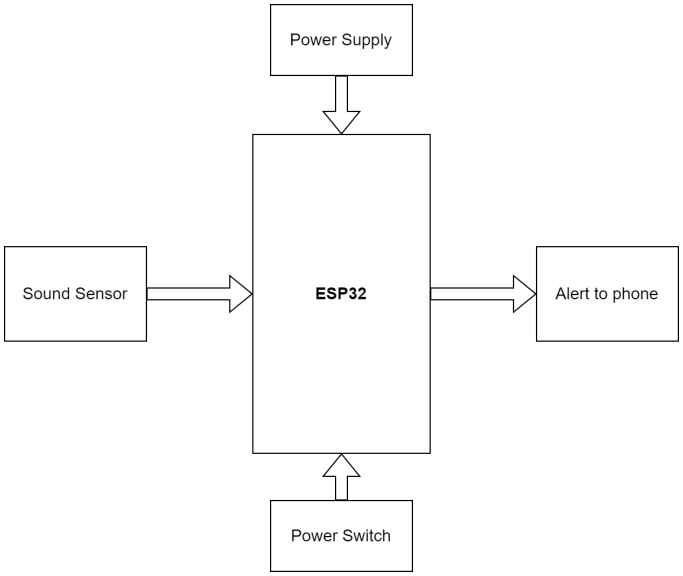

Figure 6.4: Block Diagram of Sender Module

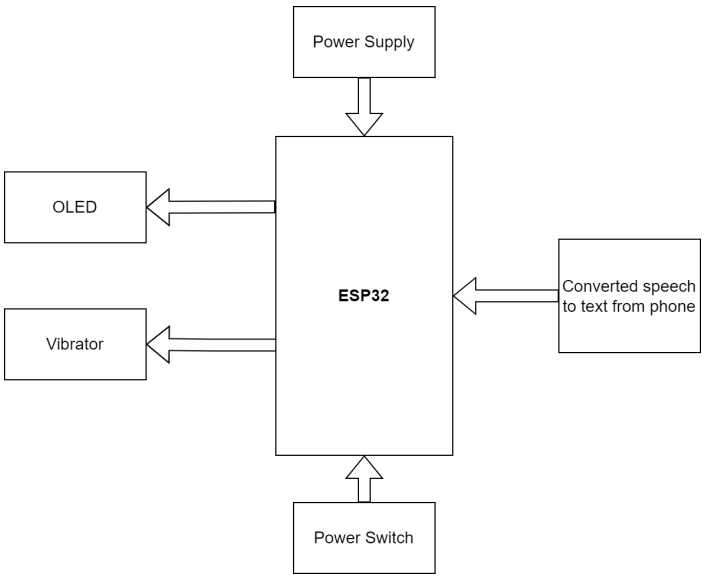

Figure 6.5: Block Diagram of Receiver Module

6.3.2 Circuit Diagram

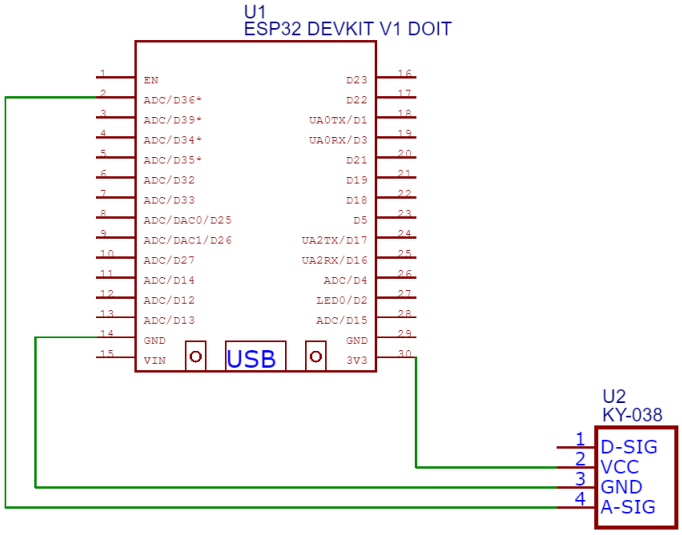

Figure 6.6: Circuit Diagram of Sender Module

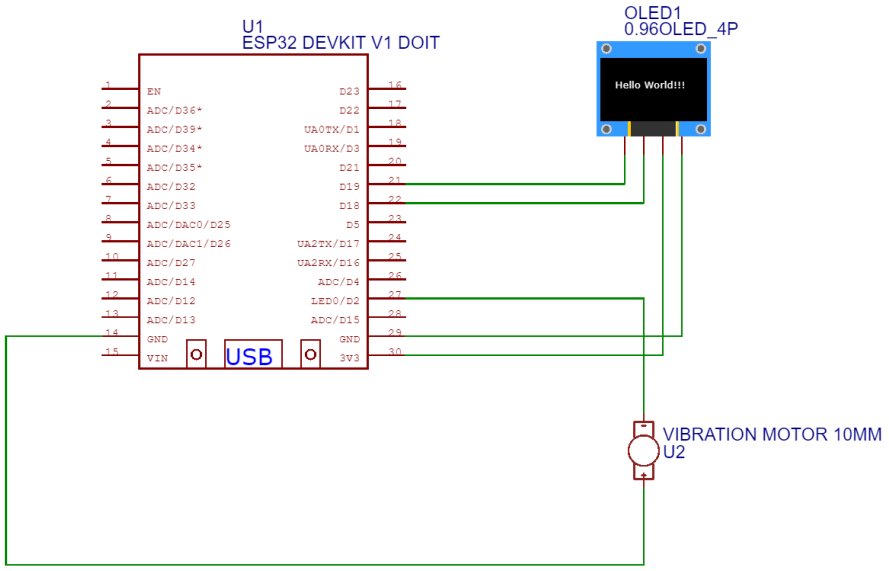

Figure 6.7: Circuit Diagram of Receiver Module

6.3.3 Flow Chart

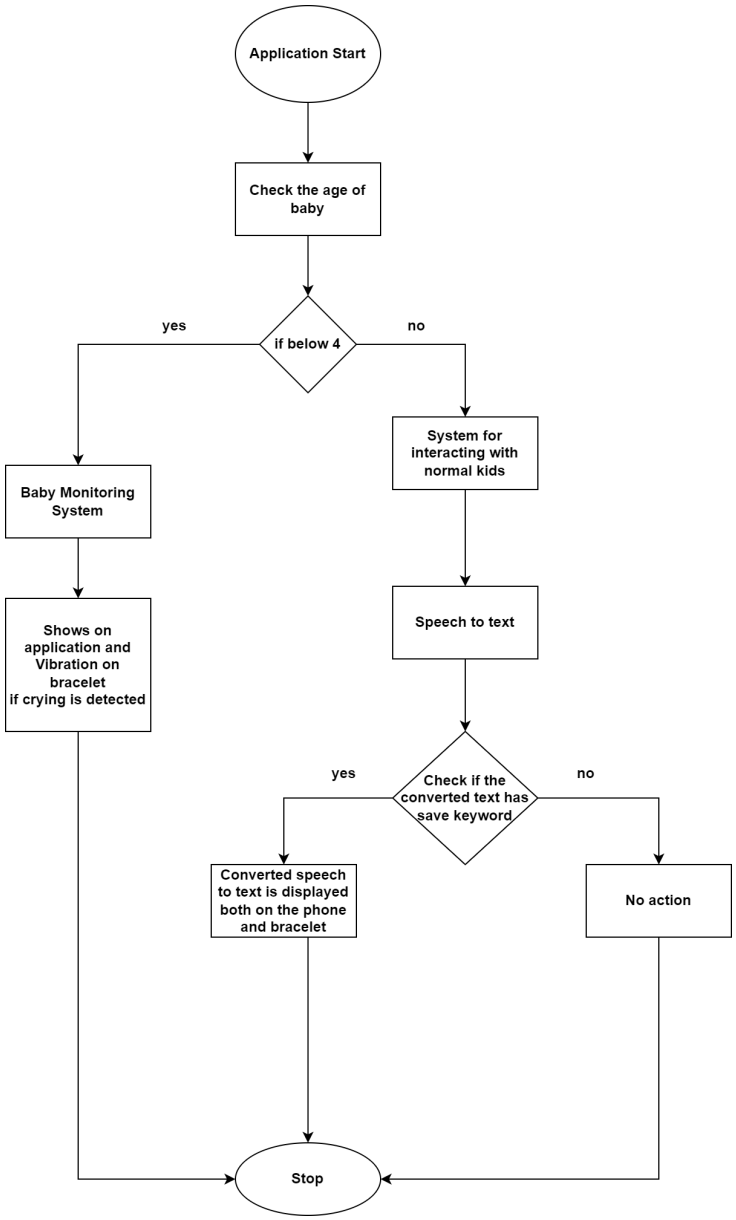

Figure 6.8: Project Flow

6.3.4 Screenshots of the User Interface

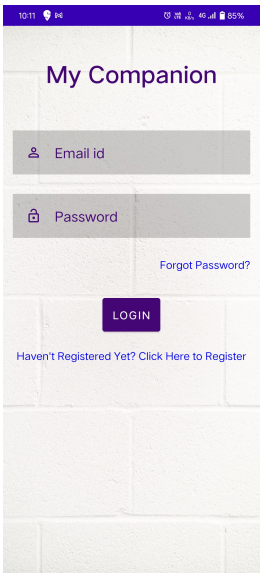

Figure 6.9: Login Page

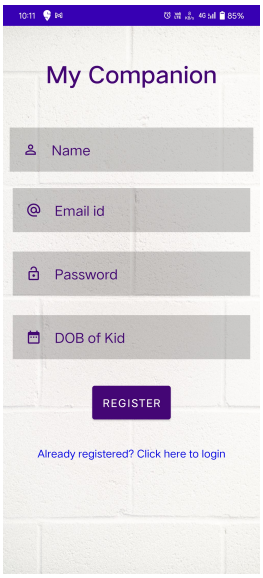

Figure 6.10: User Registration Page

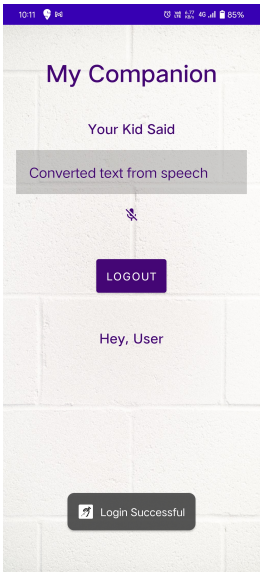

Figure 6.11: Speech to Text Display Page

6.4 Implementation

Basically there is two modules, one for infants and the other for normal kids. If the child is an infant, noise detection around the kid is done and sends alert to the deaf parent via application as well as bracelet. If the child is a normal kid, the call of the kid is detected through automatic speech recognition and send the alert to the parent via bracet and application.The bracelet contains a micro vibration motor and OLED, for alerting and displaying children's calls. This helps the deaf parents' easy interaction with their children.

Chapter 7

Coding

Algorithm 1 Algorithm for audio detection:

1: Start.

2: Boot the device.

3: Connect to WiFi.

4: Checks for the threshold value.

5: If exceeds, then send the value to the server.

6: Stop.

Algorithm 2 Algorithm for Vibration and Display:

1: Start.

2: Boot the device.

3: Connect to WiFi.

4: If child is infant, then do step 5.

5: If sound is detected according to Algorithm 1, then Display in OLED and alert via vibration.

6: If child is normal kid, then do steps 7 and 8.

7: Convert speech to text.

8: If the converted text matches with the keyword, the display the converted text in application and OLED display and send alert via vibration.

9: Stop.

Chapter 8

Testing

System testing is the step in the implementation process that verifies the system works properly and efficiently before it goes live. Testing is the process of running the code to look for errors and missing operations, as well as thorough verification to determine if the goals are fulfilled and the user requirements are met. The primary goal of testing is to guarantee that the system meets all functional and quality requirements (Non-functional requirements).

At the end of the project development cycle, the user should verify that the project fulfilled or exceeded all of their criteria. Any changes, additions, or omissions to the requirements document, functional specification, or design specification must be documented and tested as thoroughly as possible given the project's remaining time frame and the capabilities of the test team. The secondary purpose of application system testing is to detect and report any faults or hazards, as well as to guarantee that any known issues are resolved prior to release.

8.1 Unit Testing

SLNO	PROCEDURE	EXPECTED RESULT	ACTUAL RESULT	PASS OR FAIL
1	Enter email id and press the LOGIN Button	Error should be displayed for missing of data	Same as expected	pass
2	Enter the password and press the LOGIN Button	Error should be displayed for missing of data	Same as expected	pass
3	Enter data with incorrect format and press register button	Error should be displayed for incorrect format	Same as expected	pass
4	Speak without the saved keyword like ”papa”	System should not display anything	Same as expected	pass
5	Speak including keyword	Displays in application as well as bracelet	Same as expected	pass
6	Audio detection	Successfully detected	Same as expected	pass
7	Alert through vibration	Successfully send	Same as expected	pass

Table 8.1: Unit test cases and results

8.2 Integration Testing

SLNO	PROCEDURE	EXPECTED RESULT	ACTUAL RESULT	PASS OR FAIL
1	Integrating the whole components in a band	Integrated Successfully	Same as expected	pass
2	Develop the android application	Developed the application successfully	Same as expected	pass
3	Connect the android application and IoT devices together	Connected successfully	Same as expected	pass

Table 8.2: Integration cases and result

8.3 System Testing

SLNO	PROCEDURE	EXPECTED RESULT	ACTUAL RESULT	PASS OR FAIL
1	Call of child is identified and sending the alert via application and bracelet	Successfully identified and sent the alert	Same as expected	pass
2	Noises around the infant is detected and send alert	Successfully identified and sent	Same as expected	pass

Table 8.3: System test cases and results

Chapter 9

Results and Discussion

Aim of the project was to help deaf parents to understand what their kid said if the kid is normal kid and alert via bracelet through the detected sound disturbances such as crying and other disturbances in the case of infants. The proposed system appears to accomplish all of the expected functionalities.

9.1 Advantages and Limitations

9.1.1 Advantages

- Light weight and the application is easy to use.
- Real time detection of children's call if the child is normal kid.
- Crying and other noise disturbances for infants and detected and send alerts.
- Functionality is available if the parent wants to monitor the kid.
- Currently, there is no system with all these functionalities that are provided by our system.
- There's no need to manually convert speech to text by opening Gboard.
- No need for the kids to learn sign language, they can directly communicate with their parents.

9.1.2 Limitations

- If the kid is out of WiFi range, parents couldn't get alerted.
- System will fail if parent doesn't know how to read and write.
- There is a risk of failure due to bugs and hardware issues in case.
- All the noises around the infant is detected so parent manually need to check the state of kid if the kid is crying or not.
- System will fail if the kid is dumb.

-

Chapter 10

Conclusion and Future Scope

10.1 Conclusion

According to studies, roughly 1 percent of Indians are deaf, so the need of assisitng tools for them are very much important. This system sought to develop a smart bracelet and a special smartphone application to alert deaf parents via vibration when their children call them , after identifying the nature of the call and matching it with a list of words and situations that parents can manage and modify in the application. In addition to this, there is also facility to identify infants needs as well in my system. Also, an Android prototype of the application for the bracelet was created to demonstrate the genuine possibility of achieving the idea at a far lower cost than using other firms' goods (such as smart watches).

10.2 Future Scope

Future changes for this smart bracelet and accompanying application has lot of potential. This will make deaf parents to comfortably interact with their children without any third man's help or sign languages. In future I would like to add the following features.

- Adding machine learning for crying and non-crying classification via camera in infant module with enhanced security.
- Improve the accuracy and capacity by using Natural Language Processing for recognising calls without relying on the existing API, which typically needs connecting to the internet or relying on an open-source library.

- Deploy the system in favor for all nationalities by adding more languages.
- Adds a dumb module as well that will be useful if the parent is unable to speak.

I believe that this project will inspire many inventors to work hard to develop new creative tools that are beneficial to society and humanity by utilising technologies such as the Machine Learning/Deep Learning, IoT and accompanying electronic components.

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