



Deaf's Companion: A Smart Bracelet for Deaf Parents



GUIDED BY,
PROF. MINU R NATH

NAJIYA NAZRIN P N
S4 MCA
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Introduction



- Impairment/loss of hearing makes it impossible for parents to respond to calls of their children.
- IoT.
- Bracelet with a smart application.
- Application => Listens to children's calls => Converts sound into text => Sends alert to parents.
- Bracelet - based on ESP32 microcontroller to vibrate, enables parents to respond to their children.

Motivation and Problem Definition



- As per the WHO estimates in india, there are approximately 63 million people who are suffering from Significant Auditory Impairment, this includes partial and complete deafness.
- Loneliness and sadness are more prevalent among the deaf community, particularly when they are involved in a hearing world.
- Hearing impairment negatively affects daily tasks and life quality.
- The motivation behind the project is also the drawbacks of the existing system.
- A socially relevant topic needs to be addressed in a project.
- The project proposes a smart bracelet for deaf parents to interact with their children.

Literature Review



Abi Sen, Adnan & Bahbouh, Nour. (2021). Designing a Smart Bracelet based on Arduino for Deaf Parents to Interact with their Children. 10.1109/INDIACom51348.2021.00066.

- Deaf parents to be notified to their children's calls and respond swiftly by designing a mobile application to answer various calls from children.
- App allows parents to set up a series of keywords to be monitored, such as "papa," "mama," and so on
- Constantly records the surrounding sounds
- Then converts the sound into writing using the Google library API STT.
- Then compare results with the words saved in the settings section, and if there is a match, the app will alerts via Bluetooth to the smart bracelet.

Literature Review



N. M. Bahbouh, A. B. Alkhodre, A. A. A. Sen, A. Namoun and S. S. Albouq, "A Cost Effective IoT-based System for Monitoring Baby Incidents by Deaf Parents," 2019 International Conference on Advances in the Emerging Computing Technologies (AECT), 2020, pp. 1-6, doi: 10.1109/AECT47998.2020.9194179.

- parents to learn about their infant's needs
- continuously monitoring him via sound or image and alerting them.
- Parent wears a special bracelet

Literature Review



Karmel, A & Sharma, Anushka & pandya, Muktak & Garg, Diksha. (2019). IoT based Assistive Device for Deaf, Dumb and Blind People. Procedia Computer Science. 165. 259-269. 10.1016/j.procs.2020.01.080.

- The device has separate modes for the blind, deaf, and dumb people respectively
- Raspberry Pi is the device's core component.

Existing System



- People who want to interact with deaf people uses sign languages.
- It will be a challenge if kid doesn't know sign language.
- Hearing Aids : Only for amplification.
- Android speech to text.
- In Android phone or tablet, install Gboard, then open any application that helps us to type, touch and hold microphone and say what you want written when we see "Speak now."

Disadvantages of Existing System

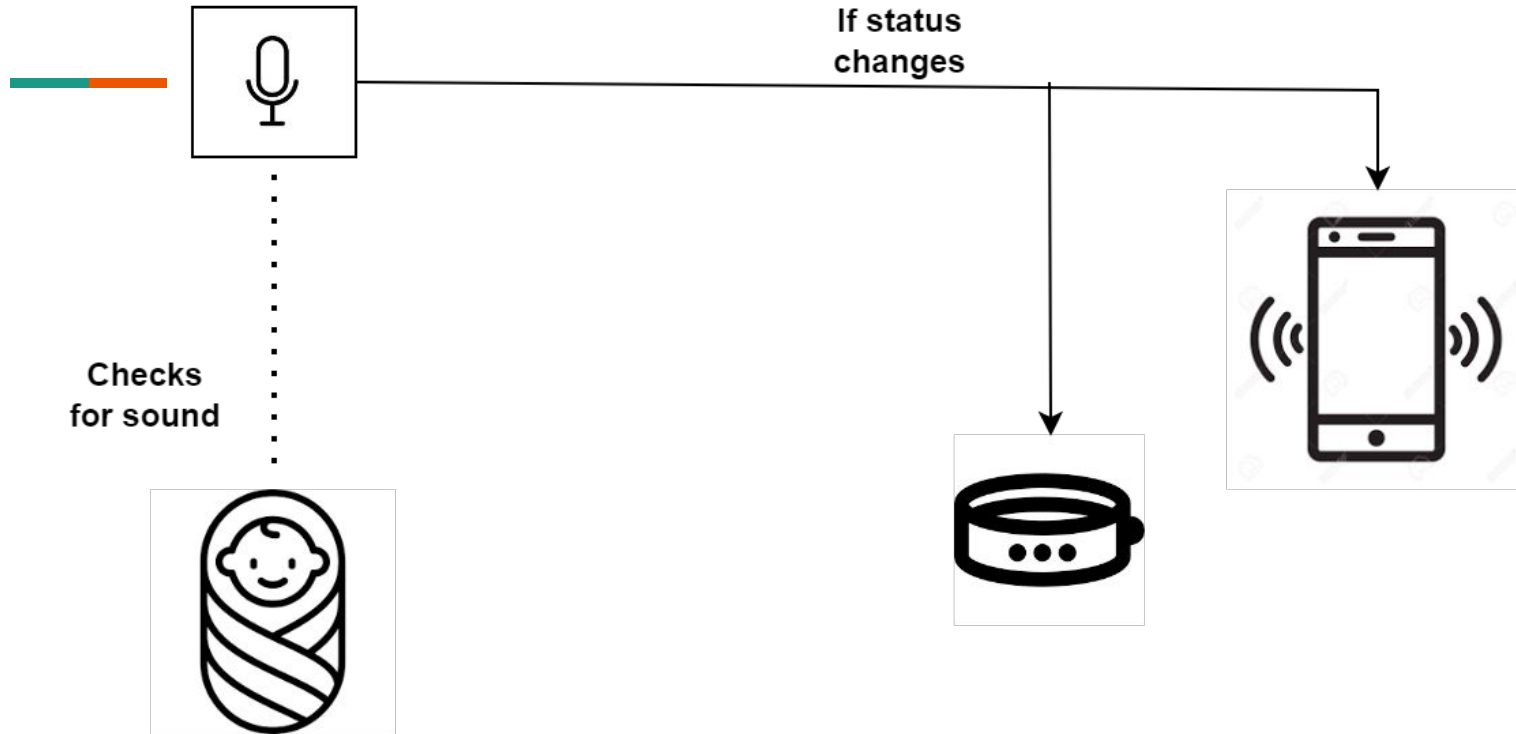


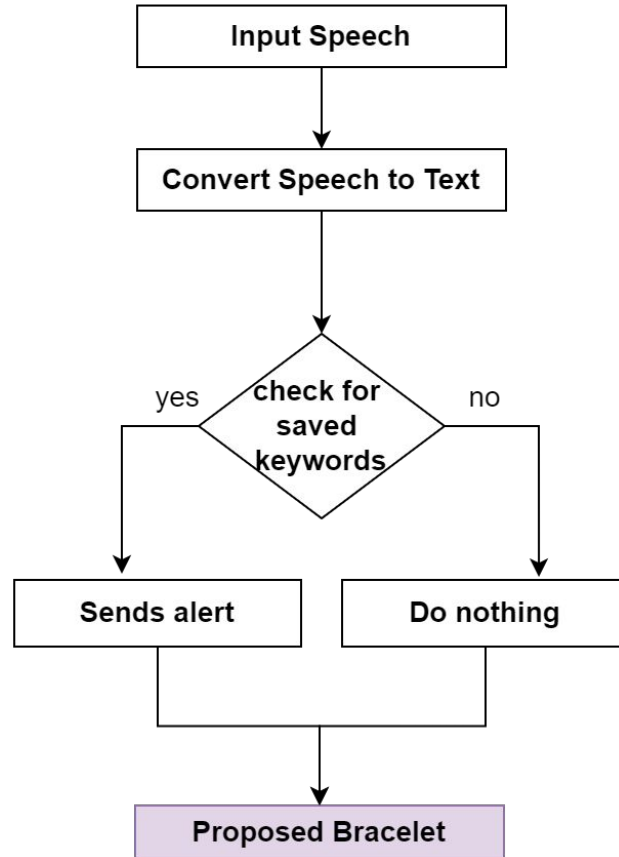
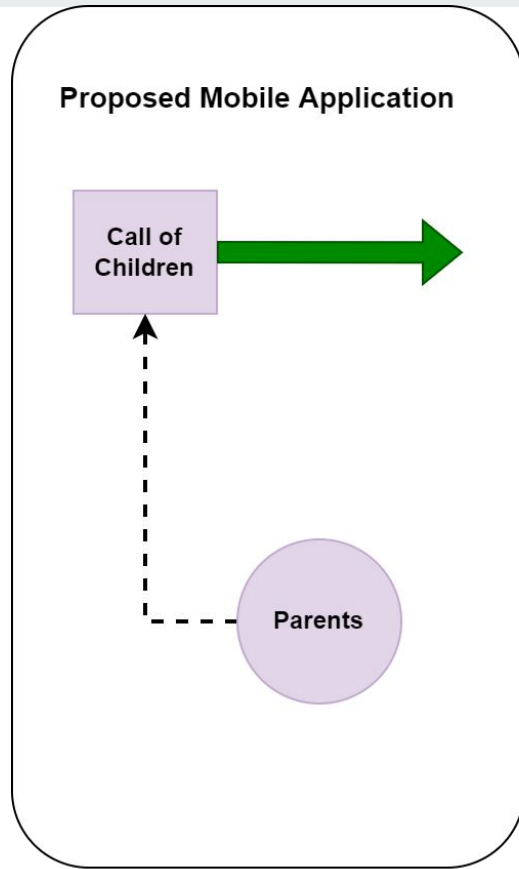
- In the first system, system will fail if the person doesn't know sign language.
- Interaction will be also challenging if the kid is blind, so speech is needed.
- Second system is time consuming since we want to manually open and app and turn the microphone on.
- Not feasible.

Proposed System



- If the child is an infant, monitoring babies for the detection of sound.
- System detects disturbing noises around the infant as well as detects whether the kid is crying using a sound sensor embedded with a microphone.
- Identifies changes, sends vibrating alerts.
- If the child is a normal kid, parents could understand different calls of their children as well.
- Call of kid is detected with the help of set of keywords such as “papa”, “mama”.
- Send alerts via WiFi to the smart bracelet and converted speech is displayed.
- Also uses ESPNOW protocol.





Advantages of Proposed System



- 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.

Components

- ESP32 microcontroller
- Micro Vibration motor
- Microphone sound sensor
- Band for body of smart bracelet
- OLED display



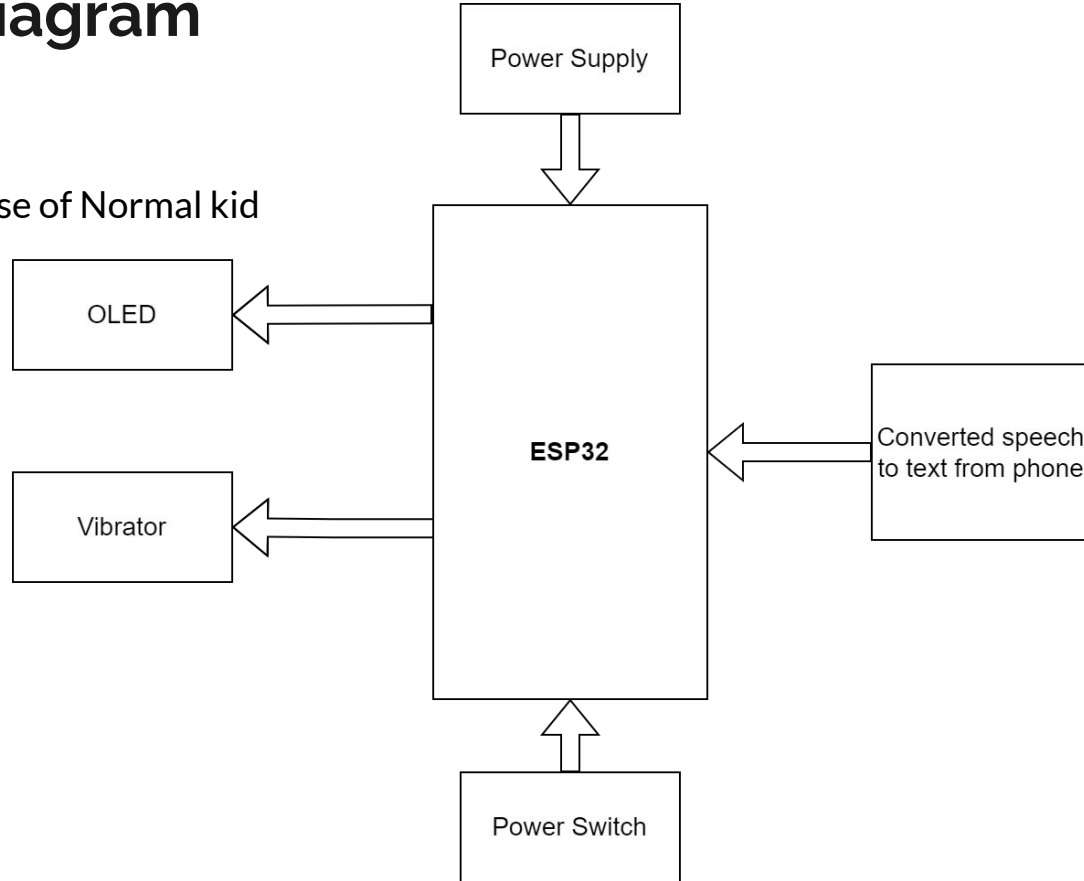
Technology Behind and Software Used



- Android Studio (For developing android application)
- Arduino IDE 1.8.19 (To configure the board)
- Firebase (Saving the data)
- ESPNOW Protocol (For sender receiver communication)

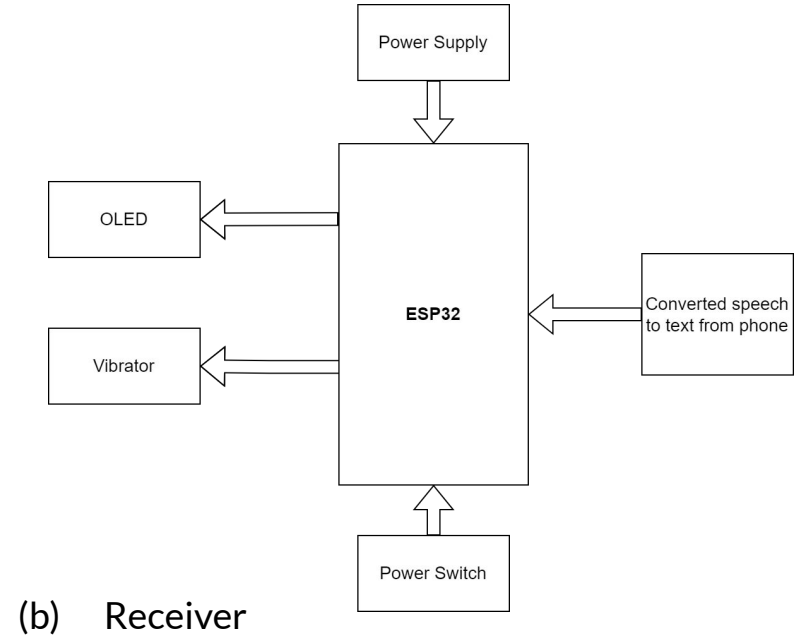
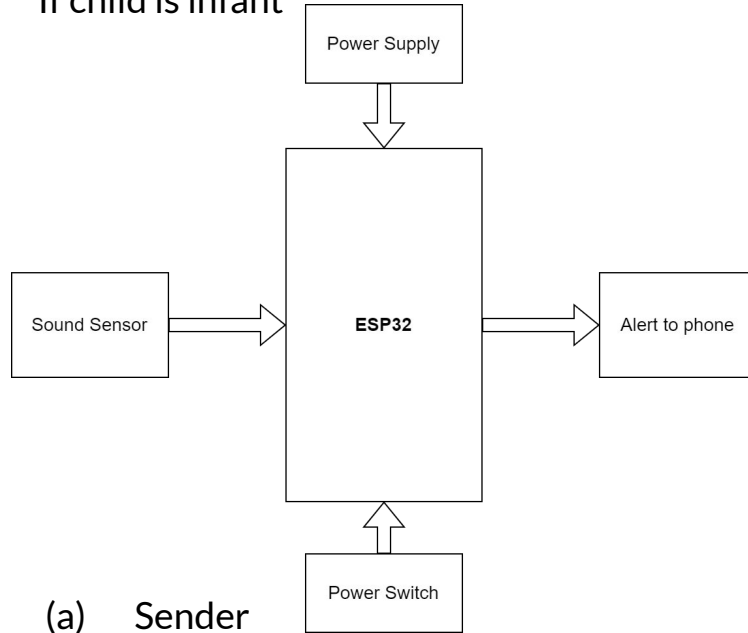
Block Diagram

- In the case of Normal kid

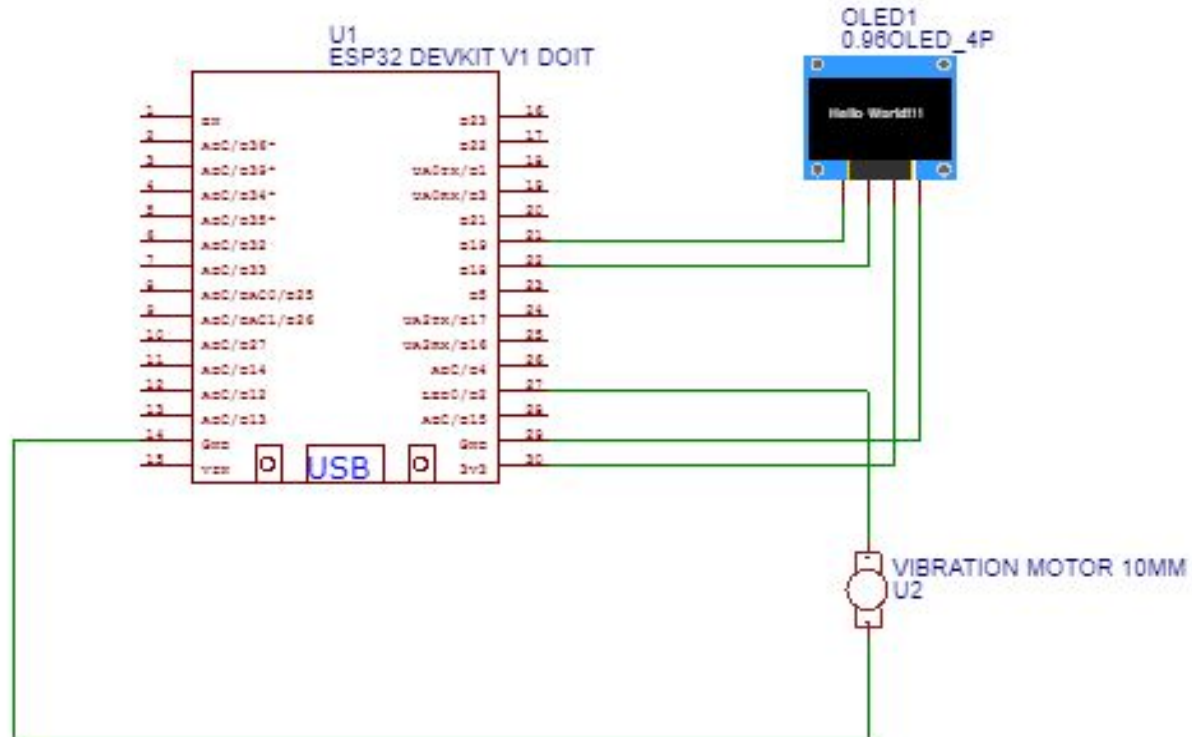


Block Diagram

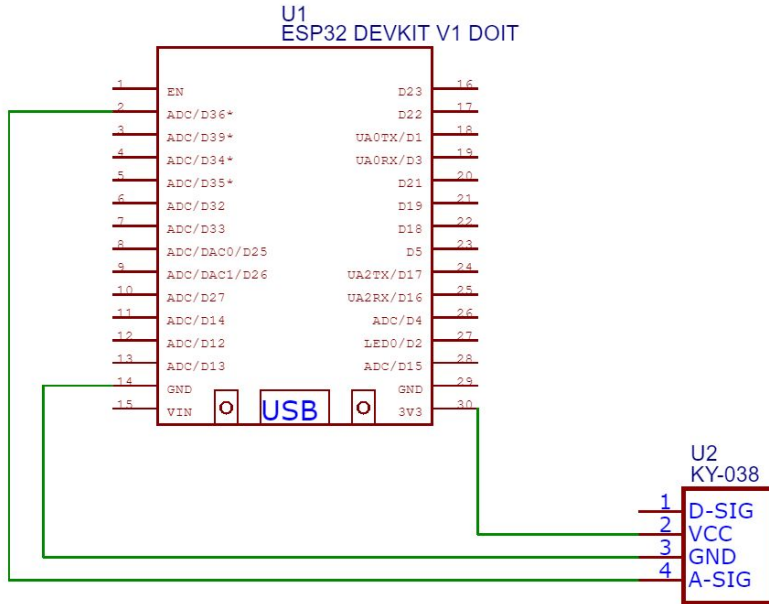
- If child is infant



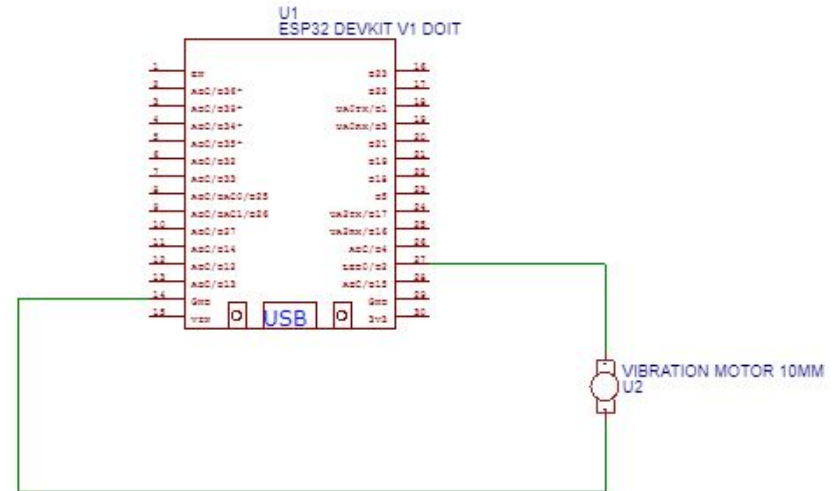
Circuit Diagram



Circuit Diagram

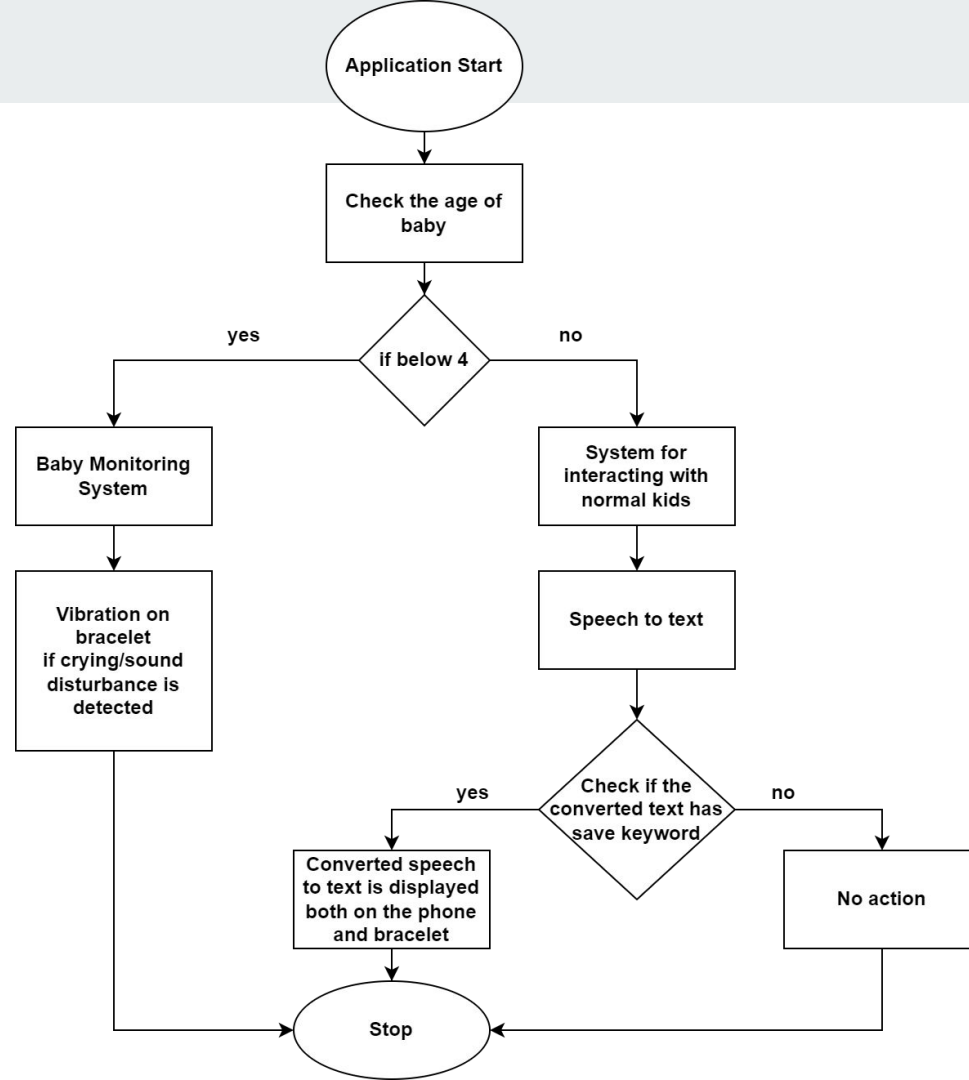


(a) Sender



(b) Receiver

Project Flow

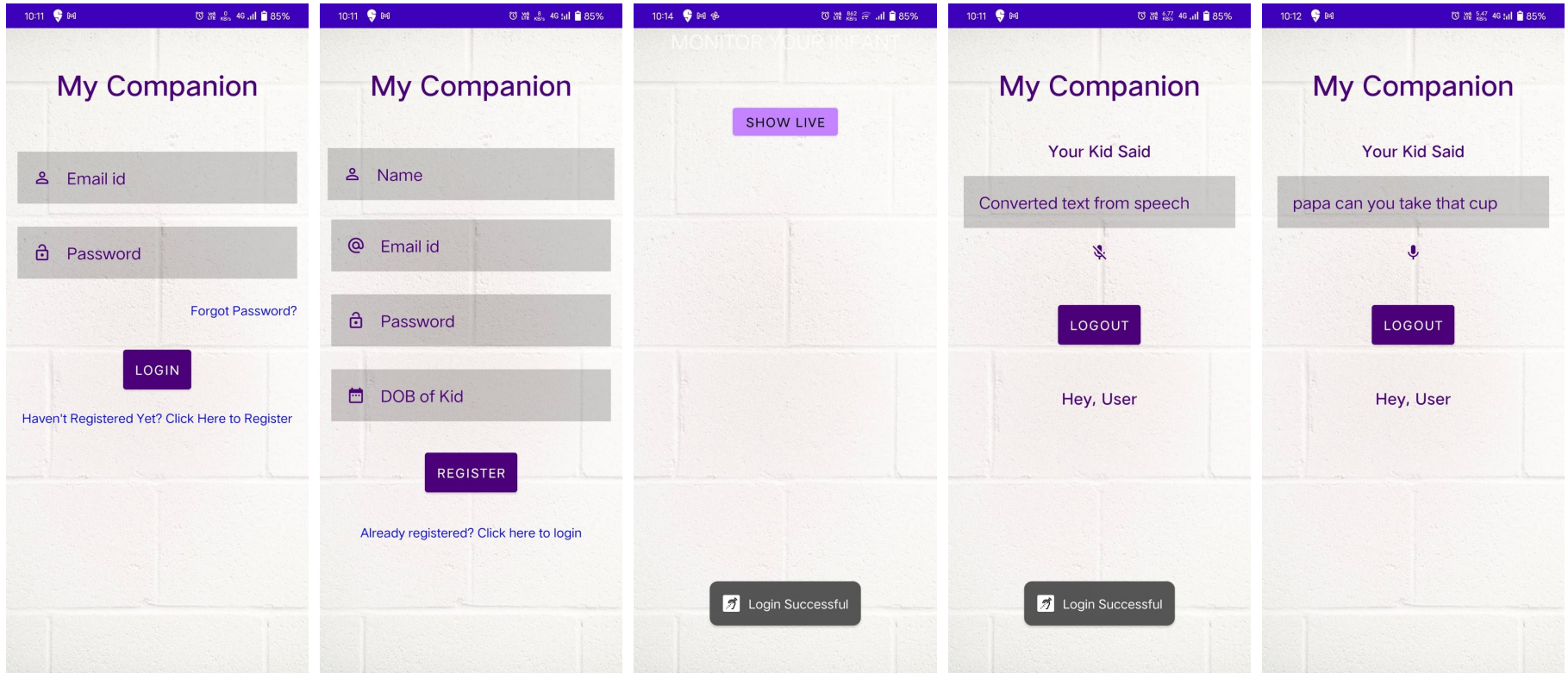


Prototype of Bracelet



Reference: [1]

Implementation



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

(a) Unit Testing

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

(b) Integration Testing

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

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.
- In case of infants, the system vibrates beyond the WiFi range.
- 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.

Disadvantages



- 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.
- Loud noises around the infant is detected so parent need to check the state of kid if the kid is crying or not.
- System will fail if the kid is dumb.

Future Work



- 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.

References

- [1] **Abi Sen, Adnan & Bahbouh, Nour. (2021). Designing a Smart Bracelet based on Arduino for Deaf Parents to Interact with their Children. 10.1109/INDIACom51348.2021.00066.**
- [2] **AN. M. Bahbouh, A. B. Alkhodre, A. A. A. Sen, A. Namoun and S. S. Albouq, "A Cost Effective IoT-based System for Monitoring Baby Incidents by Deaf Parents," 2019 International Conference on Advances in the Emerging Computing Technologies (AECT), 2020, pp. 1-6, doi: 10.1109/AECT47998.2020.9194179.**
- [3] **Karmel, A & Sharma, Anushka & pandya, Muktak & Garg, Diksha. (2019). IoT based Assistive Device for Deaf, Dumb and Blind People. Procedia Computer Science. 165. 259-269. 10.1016/j.procs.2020.01.080.**
- [4] **February 17, 2021, Ravi Teja, accessed on 15/06/2022,
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Deaf's Companion: A Smart Bracelet for Deaf Parents*

*Note: Sub-titles are not captured in Xplore and should not be used

Najiya Nazrin P N
Dept. of Computer Applications
College of Engineering, Trivandrum
Kerala, India
najiyanazrinpn@gmail.com

Prof. Minu R Nath
Dept. of Computer Applications
College of Engineering, Trivandrum
Kerala, India
minureghunath@cet.ac.in

Conference Paper

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.

Index Terms—IoT, ESP32

I. 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.

II. LITERATURE REVIEW

A. Designing a Smart Bracelet based on Arduino for Deaf Parents to Interact with their Children[1]

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