# INDUSTRIAL PROJECT REPORT

Internship project report on

## Intelligent Voice Control Wearable

submitted in partial fulfilment of the
Requirements for the award of

**Bachelor of Engineering**
**in**
**School of Electronics and Communication Engineering**

Carried out at

**Cypress Semiconductor (An Infineon Technologies Company)**


**Submitted By-**
**Shridatha Mohan Hegde**
**01FE18BEC171**


Under the guidance of


**Prof. Tanuja R. Patil**
Professor, School of Electronics
KLE Technological University

**Mr.Arvind Krishnan**
Solutions Engineer
Infineon Technologies


**SUBMITTED TO:**
**School of Electronics and Communication Engineering**
**KLE TECHNOLOGICAL UNIVERSITY**
**Hubballi**

# DECLARATION

I hereby declare that the Industrial Internship Project Report entitled **INTELLIGENT VOICE CONTROL WEARABLE** is an authentic record of my own work as requirements of Industrial Internship Project during the period from Jan 15, 2022 to June 30, 2022 for the award of degree of Bachelor of Engineering at KLE Technological University,Hubballi under the guidance of Prof. Tanuja R. Patil

**Shridatha Mohan Hegde**

**01FE18BEC171**

**Date:**

K.L.E SOCIETY'S
KLE Technological University,
HUBBALLI-580031
2021-2022

# CERTIFICATE

This is to certify that project entitled "Intelligent Voice Control Wearable" is a bonafide work carried out by student Shridatha Mohan Hegde, bearing University Seat No.01FE18BEC171, in Cypress Semiconductor(An Infineon Technologies Company), in partial fulfillment for the award for Bachelor of Engineering in Electronics and Communication in the School of Electronics and Communication Engineering of KLE Technological University, Hubballi for the academic year 2021-2022.

| | | |
|---|---|---|
| **Prof. Tanuja R. Patil**<br>**Guide** | **Dr. Nalini C. Iyer**<br>**Head of School** | **Dr. N.H. Ayachit**<br>**Registrar** |

**External Viva:**

**Name of Examiners** **Signature with date**

1.

2.

IFIN HR- 2022
24-05-2022

# CERTIFICATE

***To Whom It May Concern***

**Formal Data:**

Student Name: Shridatha Mohan Hegde

Institution: KLE Technological University

Organization: Infineon Technologies India Pvt. Ltd.

Project Instructors/ Managers: Jaya Bindra

**Evaluation of work:**

Shridatha Mohan Hegde was working as a Student Trainee with us from 20-Jan-2022 till 30-Jun-2022 and is working on the project "**Intelligent voice control wearable".**

Shridatha Mohan Hegde is an avid and independent learner, has good analytical & application skills and has shown exemplary performance during the internship period.

We wish Shridatha Mohan Hegde a long fruitful career and success in future endeavors.

For Infineon Technologies India Pvt. Ltd.

**Thara Aiyanna**
**HR Manager**

# ACKNOWLEDGMENT

The sense of contentment and relation that accompanies the successful completion of this project would be incomplete without mentioning the names of the people who helped me in accomplishing this project, and people whose constant guidance, support and encouragement resulted in its realization. I would like to take this opportunity to express my heartfelt gratitude to each and every individual who directly or indirectly played a role in this journey of my project and industry training.

I am grateful to **Mrs. Jaya Bindra**, Senior Manager Applications Engg and **Mr. Arvind Krishnan**,Principal Engineer Applications Engg, for being my mentors at Cypress Semiconductor (An Infineon Technologies Company), Bengaluru. Their constant support and belief is helping me to develop both personally and professionally. Their in-depth knowledge and expertise in solving issues and having regular meetings with them helped me gain insights into various industry issues related to my project. I sincerely thank Cypress Semiconductor for providing me an opportunity to work on real-time industry issues that always kept me on my toes. I also want to thank **Mr. Narayanan, Mr. Ajay, Mr. Meenakshi, Mr. Chandrashekahr, Mr. Praveen and Mr. Ashutosh** at **CSS ICW APP SOL** team, **Infineon Technologies** for including me in their discussions and for providing me a friendly work environment.

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- Shridatha Mohan Hegde

# ABOUT COMPANY

Cypress Semiconductor Corporation is an American semiconductor design and manufacturing company, and is now owned by Infineon Technologies. It offeres NOR flash memories, F-RAM and SRAM Traveo microcontrollers, the industry's only PSoC programmable system-on-chip solutions, analog and PMIC Power Management ICs, CapSense capacitive touch-sensing controllers, Wireless BLE Bluetooth Low-Energy and USB connectivity solutions. Its headquarters are in San Jose, California, and it has operations in the United States, Ireland, India and the Philippines.

In June 2019, Infineon Technologies announced it would acquire Cypress for 9.4 billion USD, making Infineon one of the world's top 10 semiconductor manufacturers. Infineon markets semiconductors and systems for automotive,industrial, and multimarket sectors, as well as chip card and security products.

Cypress 3.0 is the plan to target markets growing faster than the broader semiconductor industry with embedded systems solutions: combinations of MCUs, wireless connectivity, analog, USB and memory products plus the software to enable them to work together flawlessly. The solutions give innovators the foundation they need to go above and beyond. With built-in security and PSoC® MCUs, products can get to market faster, safer and smarter. Embedded systems enable solutions that sense, connect, learn and respond to make life easier, save time and energy, and provide a better user experience. It is committed to the success of the customers, the development of the employees, and the increase of shareholder value

# ABSTRACT

In the era of IoT, as devices become more and more portable it has become important trend of developing human computer interaction. An embedded intelligent system has an embedded, Internet-connected computer which can gather and analyze data and communicate with other systems. Additionally, these systems have the ability to learn from experience, security, connectivity, the capacity for remote monitoring and management, and can adapt themselves according to current data. These systems also include interconnected collections of these devices, such as sophisticated AI-based software systems, and expert systems.

In recent years, embedded intelligent systems have emerged as a big opportunity for the technology suppliers, system vendors, and service providers, due to the rapid migration to more intelligent systems across the traditional embedded systems marketplace.

This report elaborates how a 3D modelling software can be controlled via USB mouse HID commands based on voice and motion gestures trained with machine learning models.

# Contents

# List of Tables

# List of Figures

# Chapter 1

# Introduction

## 1.1 Motivation

It is difficult for a person with non-mechanical background to understand and work with 3D software like CAD, which requires some expertise in navigating through the interfaces and views, and lots of shortcuts are involved. The motive is to make this task a bit simpler, by using Voice and gesture commands, using products from Infineon portfolio .

## 1.2 Objectives

- To develop a potential wearable AI based solution using voice and gesture, using PSoC6.
- To reduce the latency and increase security by enabling edge processing.

## 1.3 Problem statement

To develop an Intelligent Voice control Wearable solution

## 1.4 Organization of the report

The report is divided into 5 parts. Each part (chapter) deals with different aspects of the project.

1. Chapter 1 discusses about the motivation behind the project, main objectives, formation of the problem statement.
2. Chapter 2 discusses about the Functional System Design.
3. Chapter 3 discusses about the proposed methodology and its architecture specifications.
4. Chapter 4 discusses about the results achieved of the proposed methodology used to get the result.
5. Chapter 5 provides the conclusion and briefs on the future scope of the project.

The Appendix Section states all the references used in the project.

# Chapter 2

# System design

In this chapter, we discuss about our proposed design, which includes steps for setting up various tools required for the proper functioning of the system. This chapter also gives an insight about the system framework used in this project.

## 2.1 Functional block diagram

Systems design is the process of defining the architecture, product design, modules, interfaces, and data for a system to satisfy specified requirements. We shall discuss the proposed system framework for the problem statement.

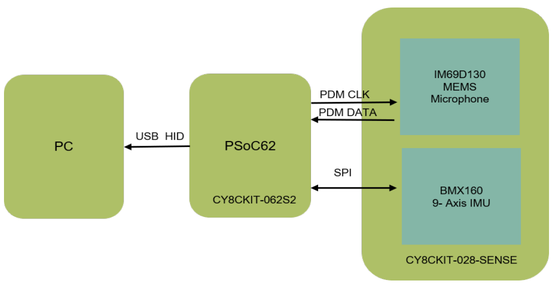



Figure 2.1: Functional block diagram of solution

## 2.2 System Framework

The tools used while working on the project have been listed below. The explanation on how each tool used in this project is explained in the next sections.

| Tool | Usage |
|---|---|
| PSoC™ 6 WiFi-BT Pioneer Kit | Dual Core CPU for Edge Processing |
| CY8CKIT-028-SENSE | Interface a variety of sensors with the PSoC™ 6 MCU |
| USB | HID commands |
| ModusToolbox™ IDE | Powerful standalone compiler, debugger |
| DesignSpark Mechanical | Open source 3D software |

Table 2.1: Proposed System Framework

# Chapter 3

# Proposed Methodology

## 3.1 Specifications and System Architecture

### 3.1.1 PSoC™ 6

The PSoC™ 6 WiFi-BT Pioneer Kit features-

- The PSoC™ 62 MCU: a single- or dual-core MCU, with an Arm Cortex-M4 and Arm Cortex-M0+
- 1MB of Flash, 288KB of SRAM, 102 GPIO, 7 programmable analog blocks, 56 programmable digital blocks
- Full-Speed USB, a serial memory interface, a PDM-PCM digital microphone interface
- Using the industry-leading 4th generation CAPSENSE™ provided in the PSoC 62 Line, self- and mutual-capacitive-sensing systems can be evaluated with this kit.
- Supports FreeRTOS and Mbed SDK

### 3.1.2 CY8CKIT-028-SENSE

Figure 3.1: IoT Expansion kit

- IoT sense expansion kit with Arduino™ UNO compatible shield board that can be used to easily interface a variety of sensors with the PSoC™ 6 MCU platform.
- Targeted specifically for audio and machine learning applications.
- Includes MEMS Microphone, Barometric Air Pressure Sensor, 9-axis Absolute Orientation Sensor, Audio Codec and headset jack, OLED Display Module

## 3.2 Implementation details

For executing the objectives mentioned in chapter 1, it's required to deal with Digital MEMS Microphone, for voice input and 9-axis Absolute Orientation Sensor for getting roll and pitch angle.

### 3.2.1 Digital MEMS Microphone

There are two digital MEMS microphone present on the IoT expansion kit, which benefits High fidelity and far field audio recording. The other features include-

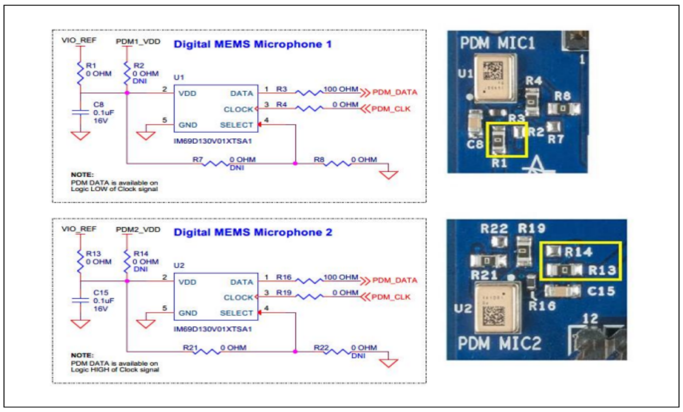



Figure 3.2: Digital MEMS Microphone

- Matched, noise and distortion free audio signals for advanced audio signal processing.
- Ultra-low group delay for latency-critical applications.
- 69 dB(A) signal-to-noise ratio

### 3.2.2 IMU

The 9-axis absolute orientation sensor is capable of interfacing with both SPI and I2C to the host MCU. The board supports both options but SPI is used by default.

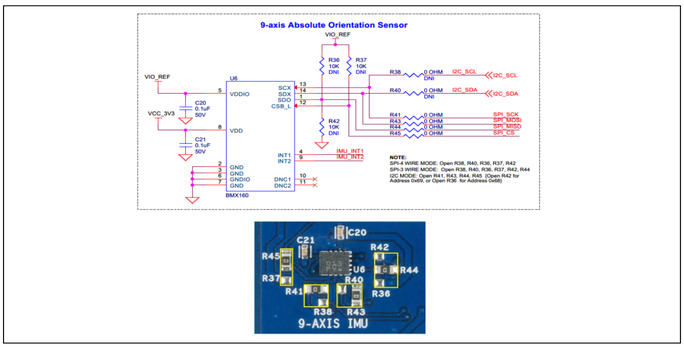



Figure 3.3: Digital MEMS Microphone

The key features include-

- High performance with low power consumption.
- Built-in Power Management System
- Hardware sensor timestamps for accurate sensor data fusion
- Extended I2C mode with clock frequencies upto 1 MHz

## 3.3 Algorithm

### 3.3.1 Setting up the Board peripherals

| **Peripheral** | **Configuration** |
|---|---|
| BSP | Setup HAL for system wide state, set system voltage |
| CPU Clock | 150MHz |
| SPI Clock frequency | 16MHz |
| I2C Clock frequency | 4MHz |
| Board UUID | dc 40 96 14 46 17 ff ef |

Table 3.1: PSoC™ 6 configurations

### 3.3.2 Setting up PDM microphone

| **Peripheral** | **Configuration** |
|---|---|
| Audio system clock | 48MHz |
| Audio record buffer size | 512 bytes |
| Audio recording frequency | 16MHz |

Table 3.2: IM69D130 configurations

### 3.3.3 Setting up IMU

| **Peripheral** | **Configuration** |
|---|---|
| Accelerometer output data rate | 100MHz |
| Accelerometer sensitivity resolution | 8192 LSB/g |
| Gyroscope output data rate | 100MHz |
| Gyroscope sensitivity resolution | 250DPS |

Table 3.3: BMX160 configurations

# Chapter 4

# Results and discussions

## 4.1 Result Analysis

To detect the user's wake word and intent, PicoVoice is used. Picovoice is a scalable cloud-based platform for designing voice interfaces and training speech models. It provides API support across multiple platforms, which describes what to do with the text input and export them as trained models.

PicoVoice uses technique of Transfer Learning, which mimics just like how humans learn new words. It has a unique feature of trigger and train (called as Porcupine Engine) which means one can simply type in a phrase and it will train a model specific to that phrase. This is called wake word, meaning this is used as invoking command for the edge device, such as "Hey Google". The file is available in .PPN extension to download.These models are then deployed into the edge devices.

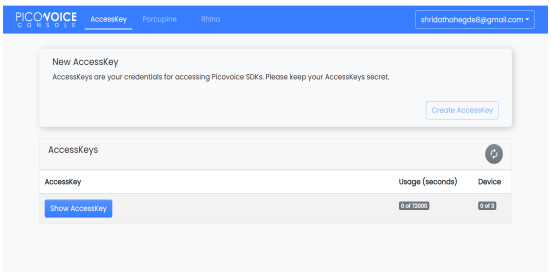



Figure 4.1: Private Access key for accessing PicoVoice SDK

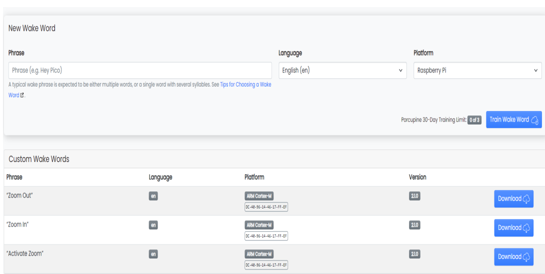



Figure 4.2: PicoVoice Console

Custom gestures has been implemented for the easy control of Design Spark 3D software. These gestures are mapped to voice commands trained over PicoVoice. For more precise zoom control, absolute orientation angles of roll and pitch are used. The gestures inputs come through as Mouse HID commands via PSoC™ 6.

| Wake Word | USB mouse gesture sent to software |
|---|---|
| "Show Component" |  |
| "Activate Zoom" |  |
| "Cancel This" |  |
| "Go to Home" |  |

Figure 4.3: Wake word mapping to USB HID Gesture

## 4.2 Output

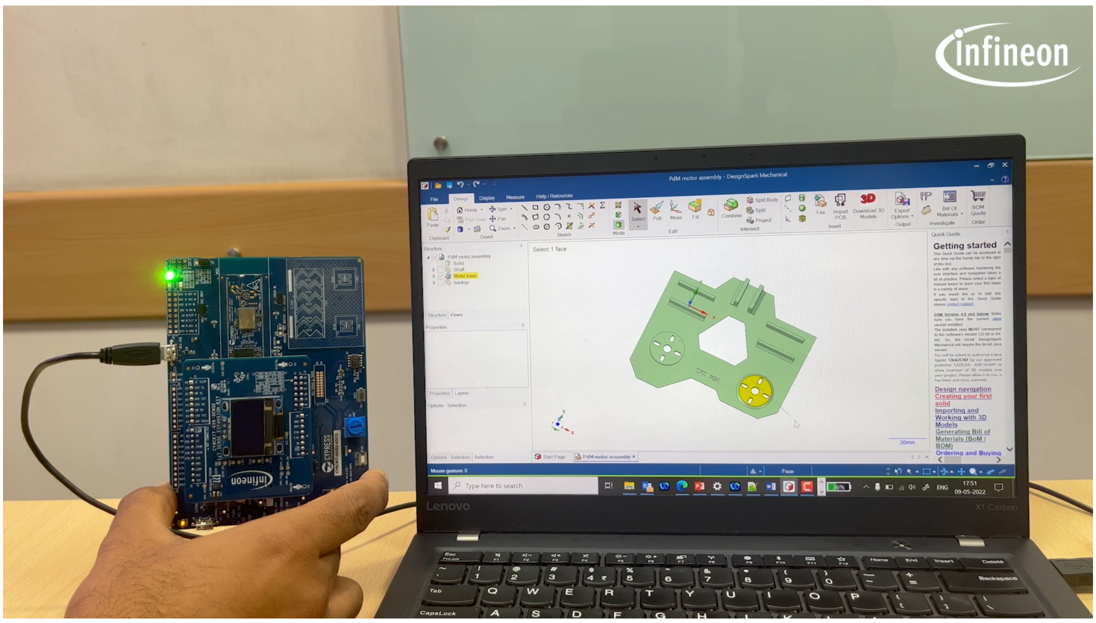



Figure 4.4: Output result

# Chapter 5

# Conclusions and future scope

## 5.1 Conclusion

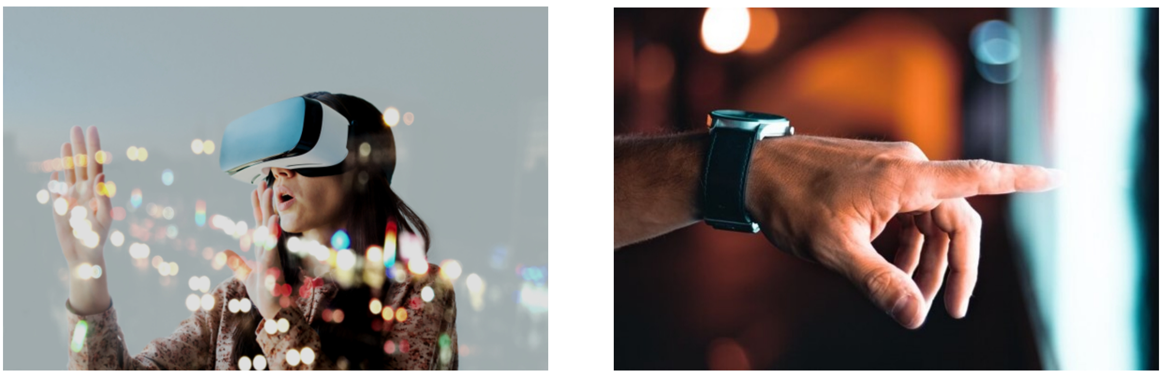
We here in the ICW solutions group at Infineon, make different kinds of solutions including proof of concept and this hobby project can be very useful in developing our solutions at a faster rate by reducing the 3D modelling efforts.

## 5.2 Future scope

PSoC™ 6 powered by ModusToolbox™ and ML integration with Picovoice made putting this project together possible in a short span of time.This can be extended to include AI based motion gestures using SensiML as well, and potentially using BLE to make the entire demo wireless. This can be a potential wearable solution that integrates voice commands and motion gesture inputs to enable context awareness for the user experience.

## 5.3 Application in the societal context

This can be a potential wearable solution that integrates voice commands and motion gesture inputs to enable context awareness for the user experience and can be used in VR applications such as 3D Street Maps Navigation and Touchless Kiosks.



(a) VR (b) Kiosk

Figure 5.1: Potential Applications

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