RUAHA CATHOLIC UNIVERSITY

(RUCU)

FACULTY OF INFORMATION AND CUMMUNICATION TECHNOLOGY(ICT)

DEPARTMENT OF COMPUTER SCIENCE

PROJECT TITLE: TOUCH-FREE SOUND CONTROL SYSTEM

COURSE NAME: PROJECT MANAGEMENT

NATURE OF WORK: SYNOPSIS

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GROUP MEMBERS

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TOUCH-FREE SOUND CONTROL SYSTEM

1. Introduction

In the modern digital world, device control is still largely dependent on traditional physical interfaces such as switches, touchscreens, and keyboards. While these inputs are common, they are sometimes inconvenient, inaccessible, or unhygienic—especially in environments where hands-free use is preferred. Touch-free interaction is becoming increasingly relevant in public spaces, healthcare facilities, smart homes, and especially for users with physical disabilities.

This project proposes a **Touch-Free Sound Control System**, a software-based application capable of recognizing specific sound gestures such as claps, finger snaps, and knocks. The system uses audio processing techniques to identify sound patterns and map them to device actions. Unlike existing gesture or voice-controlled systems that require expensive hardware sensors or IoT devices, this solution uses only a standard microphone, making it **affordable, accessible, and easy to deploy**.

2. Problem Statement

Traditional device control systems require physical contact, which can be inconvenient or problematic in several scenarios:

- **Accessibility Challenges:** People with limited mobility or physical disabilities may struggle to operate switches or buttons.
- **Hygiene Concerns:** In public areas (hospitals, elevators, ATMs), physical contact increases the risk of transmitting germs and infections.
- **Hands Occupied Situations:** In workshops, kitchens, or during multitasking, users may not be able to physically touch a device to activate it.
- **Cost Barriers:** Existing touch-free systems (gesture sensors, IoT, voice assistants) require expensive hardware, sensors, or internet connectivity, making them unsuitable for low-budget users or developing regions.

Therefore, there is a need for an **affordable software-only solution** that enables touch-free control through simple sound gestures. This system must operate without requiring new hardware purchases and must be simple enough for everyday users.

3. Objectives of the Project

General Objective:

To develop a cost-effective touch-free sound control system

Specific Objectives:

1. To design a system capable of capturing and processing sound input in real-time.
2. To identify and classify specific sound gestures such as claps, snaps, and knocks.
3. To map recognized sound patterns to predefined control actions.
4. To reduce false triggers through noise filtering and pattern recognition algorithms.
5. To provide a simple user interface for configuring sound gestures and associated actions.

4. Scope of the Project

- The system will be **software-based**, requiring only a computer or smartphone microphone.
- The project will focus on recognizing sound gestures such as claps, finger snaps, and knocking patterns.
- The output actions will be demonstrated through simulated device controls (e.g., turning a virtual light on/off, controlling media).
- The system will include a minimalistic user interface for configuration and action mapping.
- The project will not implement physical smart home device control; only simulation will be demonstrated.
- The system will function in indoor environments and may be affected by excessive noise.

5. Significance of the Project

- **Accessibility Improvement:** Provides alternative interaction methods for users with disabilities.
- **Hygiene Benefits:** Reduces physical contact with shared surfaces, lowering the risk of contamination.
- **Affordability:** Requires no hardware purchase, making it ideal for low-income environments.
- **Innovation:** Proposes a software-only gesture recognition system which is rare compared to hardware-dependent systems.
- **Research Contribution:** Adds to the field of human–computer interaction, focusing on sound-based control systems.
- **Practical Use Cases:** Useful in homes, offices, schools, hospitals, and public spaces.

6. Methodology

The project will follow these structured phases:

1. Requirement Analysis

To identify user needs, target gestures, and system constraints.

2. System Design

To design architecture including:

- Sound capture module
- Signal processing module
- Gesture recognition unit
- Action mapping unit
- User interface

3. Development

- To implement sound capture using a microphone.
- To apply digital signal processing techniques (peak detection, frequency filtering).
- To implement gesture recognition (pattern matching).
- To build the UI for configuration.

4. Testing

- Test recognition accuracy for different gestures.
- Test system performance in noisy and quiet environments.
- Perform user evaluation for usability.

5. Documentation

To prepare project documentation including diagrams, test results, and evaluations.

7. System Requirements

A. Hardware Requirements

- A smartphone **or** computer/laptop
- Built-in microphone (no external hardware needed)
- Minimum 2GB RAM
- Processor: Dual-core or higher

B. Software Requirements

- **Android Studio** (for Android version)
  OR
- **Python with PyCharm** (for desktop version)
- Audio processing libraries (PyAudio, NumPy, SciPy)
- SQLite or Firebase for action logs
- Windows/Linux/Android OS
- Any text editor for configuration

8. Literature Review

Gesture recognition and touch-free control systems have been studied extensively in recent years. Most existing systems rely on hardware devices such as infrared sensors, cameras, ultrasonic modules, or IoT devices. Studies such as *Padhy et al. (2019)* show that hardware-based gesture systems achieve higher accuracy but are expensive.

Sound-based gesture recognition has attracted interest due to its simplicity. Researchers like *Arifin et al. (2021)* explored clap recognition to trigger lights using Arduino, but their solution required microcontrollers. Voice assistants such as Google Assistant and Siri use speech recognition but require internet access and cloud processing.

There is still a gap in fully **offline, software-only sound gesture systems** that are affordable and designed for low-resource environments. No significant research focuses on the combination of **clap, snap, and knock-based gesture control** without external hardware.

9. Expected Output

- A functioning software system capable of detecting sound gestures.
- A user interface allowing gesture-to-action mapping.
- Accurate identification of claps, snaps, and knocks in real-time.
- Simulated control actions (switching virtual devices on/off).
- Noise-resistant gesture recognition to reduce false triggers.
- A complete documentation report showing system design, testing, and results.

10. Conclusion

The Touch-Free Sound Control System aims to provide an innovative, low-cost alternative to traditional device control methods by enabling users to interact with devices using simple sound gestures. By removing the need for physical contact and expensive hardware, this project delivers a practical solution for smart environments, accessibility challenges, and hygiene-sensitive settings. The software-based approach makes it widely accessible, especially in low-resource areas, and contributes to ongoing research in human–computer interaction.

ATHER PROPOSED TITLES

1. HOSPITAL STAFF LEAVE MANAGEMENT SYSTEM (ANNUAL LEAVE LIMIT: 28 DAYS)

INTRODUCTION

Hospitals operate continuously and require proper staff availability to deliver quality healthcare services. Managing staff leave manually using paper forms or spreadsheets often leads to errors, delays, and policy violations.

The **Hospital Staff Leave Management System** is a computerized system designed to automate leave requests, approvals, and tracking while enforcing an **annual leave limit of 28 days** per staff member.

2. **VOICE-CONTROLLED LIGHT SWITCHING SYSTEM**

INTRODUCTION

Lighting control is an essential part of modern living and working environments. Traditional light switching systems require physical interaction, which may be inconvenient for elderly people, individuals with disabilities, or users in situations where hands-free operation is required. With advancements in voice recognition and embedded systems, voice-controlled solutions provide a smart and user-friendly alternative.

This project focuses on developing a voice-controlled light switching system that responds to predefined voice commands to control lighting. The system enhances comfort, safety, and efficiency by reducing unnecessary energy consumption and enabling remote or hands-free operation.