Smart Interactive CPR Training Application

"Your personal CPR coach - in your pocket"

Presented by : TEAM(MB5)_3_04

INTRODUCTION

1. Sudden Cardiac Arrest (SCA) is one of the leading causes of death globally. According to the American Heart Association (AHA) :

- Nearly 350,000 cardiac arrests occur outside hospitals each year in the U.S. alone.
- Survival rate is less than 10% without immediate CPR.

2. While CPR can double or triple the chances of survival, most Traditional CPR:

- Are unsure of compression depth, rate, or hand placement
- Do not receive instant feedback during practice
- Requires physical mannequins
- Is expensive, inaccessible, or limited to workshops
- Offers no real-time correction or progress tracking

OUR APPROCH

We propose a smart CPR training app that uses phone sensors and machine learning to guide users in real-time. It replaces costly equipment with an interactive, portable, and engaging solution. Key features of our solution include:

01. Real-time CPR monitoring using smartphone sensors to measure compression depth and rate.

02. Machine learning provides instant feedback on CPR quality and correctness.

03. Gamified learning with points, challenges, and virtual scenarios to boost engagement.

Problem statement

Many individuals lack the confidence and accuracy to perform effective CPR due to limited access to interactive, real-time training. This project proposes a smart mobile application that uses smartphone sensors or wearable technology to monitor CPR compression depth and rate, providing instant corrective feedback. The app will feature gamified elements for increased engagement, along with visual and voice-guided instructions and realistic virtual patient scenarios to enhance CPR skills and preparedness.

Role of Stakeholders

- Primary users of the app for learning and practicing CPR.
- Benefit: Gain confidence and skills through interactive, guided, and gamified CPR training.
- Healthcare Professionals & First Responders
- Role: Secondary users; may use the app for refresher training or patient education.Benefit: Maintain CPR proficiency and help promote widespread CPR literacy.
- Role: Integrators of the app into their curriculum.
- Benefit: Provide students with a cost-effective, engaging training tool that improves learning outcomes.
- Hospitals & Emergency Services
- Role: Supporters of community CPR education initiatives.
- Benefit: More trained bystanders increase chances of survival during out-of-hospital cardiac arrests.

Data Integration & pre-processing

Data Type	Description
Compression Depth	The vertical distance compressed in centimeters or inches per push
Compression Rate*	Number of compressions per minute (CPM).
Hand Position Accuracy	Whether hands are placed correctly on the chest.
Compression Recoil	Measure of full chest recoil between compressions.
Accelerometer & Gyroscope Data	Raw motion data from phone/wearables (X, Y, Z axes).

Data cleaning and Processing

Noise Filtering -Use smoothing techniques (e.g., moving average, Kalman filter) to clean raw sensor data.

Outlier Removal -Identify and remove unrealistic values (e.g., negative depth, 400 CPM).

Resampling & Syncing -Normalize data to uniform time intervals (e.g., 10ms or 100ms) for consistent time series analysis.

Feature Engineering- Derive features like average depth, rate, variation, rhythm consistency, etc.

KPI - Key Performance Indicator

Measures how accurately users perform CPR, including compression depth, rate, and chest recoil.

1. Real-Time Feedback

Tracks how fast and effectively the app gives corrective feedback and whether users respond to it.

2. User Engagement

Monitors session completion rates, daily/weekly active users, and participation in gamified challenges.

Working Model

In the initial version of the Smart CPR Training Application, the system evaluates CPR performance using only the timestamp of user taps or clicks during a CPR tutorial simulation. Users are instructed to tap the screen in rhythm* with chest compressions.

How It Works:

1. User taps the screen each time they simulate a compression.
2. The app records the timestamp of each tap.
3. From the time differences between taps, the app calculates the:

   Compression rate (CPM): Ideal is 100–120 compressions per minute.
   Rhythm consistency: Measures if the intervals are regular.
4. A basic rule-based model or threshold check provides feedback like:

   *Too fast
   * Too slow
   * Keep steady

Future Enhancements

To significantly improve training realism and effectiveness, future versions of the app will integrate smartphone and wearable sensors combined with machine learning (ML).

What can Be Added:

1. Motion Sensors (Accelerometer & Gyroscope):

   Detect compression depth, angle and hand movement.
   Evaluate stability, hand placement, and full recoil.

2. Wearable Devices (Smartwatches, Rings):

   Capture real-time pressure, heart rate and motion .
   Provide more accurate data than taps alone.

ML-Powered Real-Time Analysis:

Models will process sensor data to classify compressions as:

* Correct depth/rate
* Needs adjustment (e.g., "Press harder", "Slow down")
* Personalized coaching will adapt based on user's performance history.

4. AR/Camera Integration:

Use camera to detect body posture, hand placement and simulate realistic patients*.

5. Performance Tracking and Adaptive Learning:

AI will create a learning curve, track progress and adjust training modules for each user.

Thank you very much!

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