Smart Wristwatch Project

# Introduction

This project presents the design and implementation of a **smart wristwatch** based on an **STM32 microcontroller**. The device monitors key health parameters in real-time, including **heart rate** (MAX30102) and **body temperature** (TMP117). It also incorporates the STM32’s **real-time clock** for continuous timekeeping and uses an **ADC-based battery monitor** to track power status.

A **round GC9A01 LCD display** provides a clear and intuitive interface, while a **user button** allows interaction and a **vibration motor** delivers haptic feedback for alerts and notifications. Together, these features make the device a **compact and practical health monitoring solution** suitable for wearable applications and prototype develop

**CODE: GITHUB LINK:**

# <https://github.com/voltversa/wristwatch/tree/main>

# Objectives

- Measure and display heart rate using the MAX30102 pulse sensor.  
- Measure and display body temperature using the TEMP117 temperature sensor.  
- Display the current time and date using the STM32 internal RTC.  
- Display data on a 1.28” 240×240 GC9A01 round TFT LCD.  
- Monitor battery voltage and calculate battery percentage.  
- Send an alert using vibration motor

# Components Used

- STM32F103CBT6 Microcontroller  
- MAX30102 Pulse Oximeter & Heart Rate Sensor  
- Temp117 Temperature Sensor  
- GC9A01 1.28” Round TFT LCD Display  
- 3.7V LiPo Battery (700mAh)  
- RTC (Internal RTC of STM32)

- Vibration motor

# System Overview

The STM32 microcontroller is the central unit of this project. It communicates with external devices using **I2C** and **SPI** interfaces to acquire and display health-related data.

* The **MAX30102** sensor provides real-time **heart rate** measurements using photoplethysmography.
* The **TMP117** sensor delivers **high-accuracy body temperature readings**, suitable for wearable applications.
* The **GC9A01 round LCD display** presents all health data in a clear and user-friendly format.

This integration allows the STM32 to act as a **compact health monitoring system**, combining accurate sensing with an intuitive display.

# Functional Description

**Functional Description**

1. **Heart Rate Monitoring**
   * The **MAX30102** uses an infrared LED and photodiode to detect blood flow changes.
   * Pulses are processed in software, and a **rolling average** is used to calculate **BPM**.
2. **Temperature Sensing**
   * The **TMP117** provides **high-accuracy skin temperature** readings via **I2C**.
   * Outputs calibrated **16-bit digital values** directly in degrees Celsius.
3. **Real-Time Clock (RTC)**
   * The STM32’s internal **RTC** is configured with the **LSI oscillator**.
   * Continuously tracks **date and time**, even in low-power modes.
4. **Display Output**
   * The **GC9A01 round LCD display** shows **heart rate, temperature, date/time, and battery status**.
   * Information is presented in a **clear and intuitive layout**.
5. **Battery Monitoring**
   * The STM32’s **ADC** measures battery voltage through a **resistor divider**.
   * Voltage is converted into a **percentage** and displayed.
6. **User Button**
   * A **physical button** provides **user input to turn on/off display and to snooze alert**.
7. **Vibration Motor**
   * A **haptic feedback motor** is controlled by the STM32.
   * Used for **alerts, notifications, or confirmation signals** (e.g., alarm, heartbeat).

# System Block Diagram

The following image illustrates the main components and their connections in the project:

A diagram of a diagram

AI-generated content may be incorrect.

# Conclusion

This smart wristwatch project demonstrates how the **STM32 platform** can serve as the core of a **compact and wearable health monitoring device**. By integrating **heart rate sensing (MAX30102)**, **body temperature measurement (TMP117)**, **real-time clock functionality**, **battery monitoring**, **user interaction via button**, and **haptic feedback with a vibration motor**, the system delivers a **comprehensive and user-friendly experience**.

The combination of **low-power operation**, **accurate sensing**, and a **round GC9A01 display** makes it suitable for **personal health tracking** as well as a **prototype for future medical or wearable applications**.