SWE Experiment Design Project

Requirements Analysis for Wristwatch Design

1. Purpose of the Project

- To design a modern and user-friendly wristwatch.
- To develop a product that meets functional, aesthetic, and technological requirements.

2. Stakeholders

- Design team.
- Manufacturing team.
- Marketing and sales departments.
- End users (customers).

3. Functional Requirements

- **Time Display**: The watch should display hours, minutes, and seconds.
- **Date Display**: It should show day, month, and year.
- **Alarm Functionality**: Adjustable alarm settings for the user.
- **Stopwatch**: A function for measuring elapsed time.
- **Lighting**: A lighting system to ensure readability in the dark.
- **Water Resistance**: Ability to resist water up to a specific depth (e.g., 50m).

4. Non-Functional Requirements

- **Durability**: Materials resistant to scratches and impacts.
- **Battery Life**: Long-lasting battery performance.
- **Aesthetic Design**: Stylish design tailored to the target audience.
- **User Experience**: Easy-to-read display and comfortable strap design.
- **Size and Weight**: Lightweight and appropriately sized for user comfort.

5. Design Requirements

- Option for analog, digital, or hybrid displays.
- Various strap materials (e.g., leather, metal, silicone).
- Multiple color options.
- Minimalist or detailed design alternatives.

6. Technical Requirements

- **Mechanical Components**: Reliable mechanical structure for analog models.
- **Display Technology**: High-contrast screen for digital models.
- **Sensors**: If smart features are included, sensors like GPS or heart rate monitors.
- **Water Resistance Standard**: Certification such as IP67 or higher.
- **Connectivity Features**: For smart watches, options like Bluetooth or Wi-Fi.

7. Constraints

- **Cost**: Keeping production and sales costs within a defined range.
- **Production Time**: Time from design to market release.
- **Technological Limitations**: Constraints on available technology and materials.

8. Risks

- Quality issues during production.
- Misinterpretation of user needs.
- Inability to compete effectively with rival products.

9. Acceptance Criteria

- The product must meet all functional and non-functional requirements.
- It should align with aesthetic and ergonomic expectations.
- It must be producible within the defined budget and timeline.

Test Scenarios for a Wristwatch

Time Display Test Scenario:

Test Case 1: Verify that the watch correctly displays hours, minutes, and seconds.

Test Steps:

1. Set the watch to a known time (e.g., 12:30:45).
2. Observe the display.

Expected Result: The watch should display "12:30:45" accurately.

Test Case 2: Test the time display in both 12-hour and 24-hour formats.

Test Steps:

1. Switch the time format between 12-hour and 24-hour in the settings (if applicable).
2. Set the time to 3:00 PM (12-hour format) and 15:00 (24-hour format).
3. Observe the display.

Expected Result: The watch should show "3:00 PM" in 12-hour format and "15:00" in 24-hour format.

Date Display Test Scenario:

Test Case 1: Check if the watch displays the correct day, month, and year.

Test Steps:

1. Set the date to a known day (e.g., March 15, 2025).
2. Observe the display of the day, month, and year.

Expected Result: The watch should display "15 Mar 2025" correctly.

Test Case 2: Test the date functionality for leap years and transitions between months.

Test Steps:

1. Set the date to February 28, 2024 (leap year).
2. Verify the transition to February 29, 2024.
3. Change the date to March 31, 2024, and verify the transition to April 1, 2024.

Expected Result: The watch should correctly handle the leap year (Feb 29) and month transitions.

Alarm Functionality Test Scenario:

Test Case 1: Verify that alarms can be set, edited, and deleted.

Test Steps:

1. Set an alarm for a specific time (e.g., 7:00 AM).
2. Edit the alarm time (e.g., change it to 7:30 AM).
3. Delete the alarm.

Expected Result: The alarm should be set correctly, the time should be editable, and the alarm should be deleted successfully.

Test Case 2: Ensure the alarm rings at the specified time with the appropriate sound/vibration.

Test Steps:

1. Set an alarm for a specific time (e.g., 7:00 AM).
2. Wait until the alarm triggers.
3. Observe the alarm's sound/vibration.

Expected Result: The alarm should ring or vibrate at the set time.

Stopwatch Functionality Test Scenario:

Test Case 1: Test starting, pausing, and resetting the stopwatch.

Test Steps:

1. Start the stopwatch and let it run for a few seconds.
2. Pause the stopwatch.
3. Reset the stopwatch.

Expected Result: The stopwatch should start, pause, and reset correctly.

Test Case 2: Measure stopwatch accuracy against a reference time.

Test Steps:

1. Start the stopwatch at the same time as a reference timer.
2. Measure the elapsed time on both the wristwatch and reference timer.

Expected Result: The wristwatch should match the reference timer's elapsed time within an acceptable margin of error.

Lighting Test Scenario:

Test Case 1: Verify that the backlight activates when required.

Test Steps:

1. Press the backlight button (if available) or check the automatic backlight feature in low-light conditions.
2. Observe the screen.

Expected Result: The screen should light up when the button is pressed or in low-light conditions.

Test Case 2: Test the readability of the display in low-light and bright-light conditions.

Test Steps:

1. Observe the display in a dark room.
2. Observe the display under direct sunlight.

Expected Result: The display should be legible in both low-light and bright-light conditions.

Water Resistance Test Scenario:

Test Case 1: Submerge the watch to the specified depth and check for functionality.

Test Steps:

1. Submerge the watch to the rated water resistance depth (e.g., 50m).
2. Check if the watch continues to function correctly.

Expected Result: The watch should remain functional and not leak.

Test Case 2: Test resistance to short-term water exposure (e.g., splashes or rain).

Test Steps:

1. Expose the watch to rain or a splash of water.
2. Observe the watch's functionality after exposure.

Expected Result: The watch should function correctly and remain undamaged.

Durability Test Scenario:

Test Case 1: Perform scratch tests on the watch glass and strap.

Test Steps:

1. Scrape the watch glass and strap with a fine abrasive.
2. Observe for scratches or damage.

Expected Result: The glass and strap should show minimal damage based on the material's durability.

Test Case 2: Drop the watch from standard wrist height and check for damage.

Test Steps:

1. Drop the watch from a height of approximately 1 meter.
2. Observe any physical damage to the watch.

Expected Result: The watch should show no significant damage from the drop.

Battery Life Test Scenario:

Test Case 1: Measure battery performance under normal and intensive usage conditions.

Test Steps:

1. Use the watch in a standard way for a day.
2. Use the watch with the alarm, stopwatch, and backlight for an extended period.

Expected Result: The battery should last for the expected duration under both normal and intensive use.

Test Case 2: Test low-battery indicators and functionality when the battery is nearly depleted.

Test Steps:

1. Simulate low battery conditions (e.g., under 10%).
2. Observe if the low-battery indicator appears.
3. Test basic functionalities like time display and alarm.

Expected Result: The low-battery indicator should appear, and essential functions should still work.

Design and Comfort Test Scenario:

Test Case 1: Check if the watch fits comfortably on wrists of different sizes.

Test Steps:

1. Fit the watch on wrists of varying sizes.
2. Observe comfort and adjustability.

Expected Result: The watch should fit comfortably on wrists of all sizes.

Test Case 2: Verify that the strap material does not cause irritation or discomfort.

Test Steps:

1. Wear the watch for an extended period.
2. Observe if the strap material causes discomfort or irritation.

Expected Result: The strap should be comfortable and not cause irritation

Weight Test Scenario:

Test Case 1: Ensure the watch's weight does not exceed specified ergonomic limits.

Test Steps:

1. Measure the weight of the watch.

2. Compare it to the maximum weight specification.

Expected Result: The watch weight should be within the specified ergonomic limit

Aesthetic Check Test Scenario:

Test Case 1: Verify that the watch meets the design expectations for different color and material variants.

Test Steps:

Compare the watch's color and material with the design specifications.Check if the watch is available in all promised variants.

Expected Result: The watch should match the color and material specifications.

Traceability Matrix

Requirement No	Requirement Description	TestCase ID	Status
1	Time Display	TC1, TC2	Passed
2	Date Display	TC3, TC4	Passed
3	Alarm Functionality	TC5, TC6	Failed
4	Stopwatch Functionality	TC7, TC8	Passed
5	Lighting	TC9, TC10	Passed
6	Water Resistance	TC11, TC12	Failed
7	Durability	TC13, TC14	Passed
8	Battery Life	TC15, TC16	Passed
9	Design and Comfort	TC17, TC18	Failed
10	Weight	TC19	Passed

Technical Requirement Document (TRD).

T1   When the user presses any button, the screen should turn on.

T2   If T1 is provided. Display time.

T3   When the user presses mode button, user should choose date mode.

T4   If T3 is provided. Display date.

T5   When the user presses alarm button, the screen should pass to alarm settings.

T6   If T5 is provided. Adjust alarm.

T7   When the user presses mode button, user should choose stopwatch mode.

T8   If T7 is provided. Start stopwatch.

T9   When the user presses light button, the screen should light up.

T10   If T9 is provided. Press the button as much as you want.

Risk Management

1. Risk Identification

A. Technical Risks

- **Defective Display or Malfunctioning Components:** If the display or other key components (such as sensors, buttons, or the battery) malfunction, it could result in inaccurate time display, incorrect data, or failure of watch functionalities.
- **Battery Life Issues:** Poor battery performance or inadequate power-saving features could result in short battery life, reducing user satisfaction.
- **Water Resistance Failure:** Failure in meeting the required water resistance standard could lead to malfunction when the watch is exposed to water.
- **Software Bugs:** Software bugs or incorrect firmware could cause the watch to freeze, display incorrect information, or fail to respond to user inputs.
- **Hardware Failure (Screen or Buttons):** Physical damage to the screen or buttons could render the watch inoperable or difficult to use.

B. Design and Usability Risks

- **Comfort and Ergonomics:** If the watch is uncomfortable or too bulky for most users, it may not be suitable for long-term wear.
- **User Interface Confusion:** If the digital interface is not intuitive, users may struggle to set alarms, change time formats, or operate the watch's features.

C. Market and Financial Risks

- **Cost Overruns:** Unexpected expenses during manufacturing, such as for additional materials or labor, could lead to cost overruns.
- **Failure to Meet Market Demand:** The product may not meet customer expectations or there may be a lack of market interest.
- **Competitor Product Launches:** Competing digital watches with better features or prices could overshadow the product in the market.

D. External Risks

- **Supply Chain Delays:** Delays in obtaining critical materials, such as the digital display or specialized components, could delay the project timeline.
- **Regulatory Compliance Issues:** The product may need to meet specific regulatory standards, such as water resistance ratings, electrical safety standards, or environmental regulations (e.g., battery disposal), which could cause delays or add costs.

2. Risk Assessment

Risk	Probability	Effects
Defective Display or Malfunctioning Components	Moderate	Serious
Battery Life Issues	High	Catastrophic
Water Resistance Failure	Moderate	Serious
Software Bugs	Moderate	Serious
Hardware Failure (Screen or Buttons)	Moderate	Serious
Comfort and Ergonomics	Low	Moderate
User Interface Confusion	Moderate	Moderate
Cost Overruns	Moderate	Serious
Failure to Meet Market Demand	Moderate	Serious
Competitor Product Launches	High	Moderate
Supply Chain Delays	Low	Moderate
Regulatory Compliance Issues	Low	Serious

3. Risk Mitigation Strategies

A. Technical Risks Mitigation

- **Defective Display/Components:** Implement thorough quality control checks during manufacturing. Conduct multiple testing phases for components before assembly.
- **Battery Life Issues:** Integrate an efficient battery design and test battery life under various conditions. Introduce energy-saving modes in the software.
- **Water Resistance Failure:** Conduct rigorous waterproof testing to meet industry standards, and ensure the watch's casing and seals are tightly constructed.
- **Software Bugs:** Perform extensive software testing, including alpha and beta testing phases. Allow users to report issues in the beta phase.
- **Hardware Failure:** Use high-quality, durable materials for screens and buttons, and ensure extensive testing for durability (e.g., drop tests, button press longevity).

B. Design and Usability Risks Mitigation

- **Comfort and Ergonomics:** Design multiple wristband options to suit different wrist sizes and shapes. Conduct ergonomic testing with a variety of users.
- **User Interface Confusion:** Design an intuitive interface with easy navigation and provide a clear user manual or on-screen tutorials for first-time users.

C. Market and Financial Risks Mitigation

- **Cost Overruns:** Monitor the budget regularly and track expenses to avoid any surprises. Have contingency funds in place for unforeseen issues.
- **Failure to Meet Market Demand:** Conduct market research to understand customer preferences and needs. Design the watch with popular features and ensure competitive pricing.

- **Competitor Product Launches:** Continuously track competitor activities and product launches. Differentiate the product by focusing on unique features or better pricing.

D. External Risks Mitigation

- **Supply Chain Delays:** Establish reliable supplier relationships and maintain an inventory buffer for critical components.
- **Regulatory Compliance Issues:** Stay up-to-date with applicable regulations and ensure the product complies with local and international standards. Perform necessary testing and certifications.

4. Risk Monitoring and Control

The risk management process will be continuously monitored, and any changes in the project that affect risk levels will be assessed. The team will hold regular meetings to discuss any emerging risks and adjust mitigation strategies as needed. Regular feedback from testing phases will also help identify risks early in the process.

5. Contingency Plans

For each identified risk, a contingency plan will be in place:

- **Backup suppliers** for components in case of supply chain disruptions.
- **Additional development time** in case software or hardware issues arise.
- **Revised product designs** or feature adjustments if user feedback indicates a need for changes.

By proactively managing risks and implementing strong mitigation strategies, the project can minimize potential setbacks and ensure the successful delivery of the digital watch.