Stress measurement using psychometrics & AR/VR Simulators

Stress and anxiety levels **can be measured indirectly** using various physiological sensors that track bodily responses correlated with stress. While these measures aren't 100% definitive for diagnosing anxiety (which is complex and often psychological), **they can offer reliable indicators**. To enhance the accuracy and reliability of stress measurement a hybrid system can be so developed that it it has the following sub-systems :

1. Psychological set-up to expose individual to different emotional situations
2. AR/VR set-up to display the situations are videos/images
3. Physiological measurement device to measure various changes inphysiology of individual
4. Automation set-up to collect all information and project it in desired format to indicate stress levels and vulnerability of an individual for self-harm and harm to others.

Following is a tentative breakdown of the **methods, equipment**, and some **AR/VR examples**:

1. **Physiological Markers and Sensors for Stress/Anxiety**

Biomarker	**Measurement**	**Associated Equipment**
Heart Rate (HR)	Elevated HR is a common stress response	ECG, PPG sensors, smartwatches, chest straps
Heart Rate Variability (HRV)	Lower HRV often correlates with high stress	ECG, chest straps, smart rings (e.g., Oura Ring)
Electrodermal Activity (EDA/GSR)	Skin conductance increases with stress	GSR sensors (e.g., Empatica E4, Shimmer)
Blood Pressure (BP)	Often elevated during stress	Digital BP cuffs, wearable BP monitors
Pulse Oximetry (SpO2)	Mild drop in oxygen saturation possible under extreme stress	Pulse oximeters
Electroencephalography (EEG)	Certain brainwave patterns (e.g., high beta waves) can indicate anxiety	EEG headsets (e.g., Muse, Emotiv)
Respiratory Rate	Rapid breathing is a stress response	Respiratory belts, smart shirts (e.g., Hexoskin)
Skin Temperature	Drops in peripheral skin temperature may occur	Infrared sensors, thermistors

Measurement Methods

1. **HRV Analysis**
    - **Time-domain**: RMSSD (root mean square of successive differences)
    - **Frequency-domain**: LF/HF ratio
    - Devices: Polar H10 chest strap, Garmin smartwatches, Oura Ring
2. **EEG Analysis**
    - Brainwave patterns (e.g., increase in beta, decrease in alpha or theta)
    - Devices: Muse 2, Emotiv Insight, NeuroSky MindWave
3. **EDA Measurement**
    - Skin conductance response (SCR) spikes indicate arousal
    - Devices: Empatica E4, Affectiva Q Sensor
4. **Multimodal Approaches**
    - Combine HRV + GSR + EEG + respiration for higher accuracy
    - Often used in research and clinical settings

2. **AR/VR in Stress/Anxiety Monitoring and Management**

Use of AR/VR for Biofeedback and Anxiety Reduction

AR/VR environments provide immersive experiences that can be combined with biosensors for real-time monitoring and **adaptive feedback**.

Examples of Equipment & Applications:

System	Tech Used	Functionality
Brain activity	EEG + VR	Monitors brain activity and provides immersive relaxation/training
General Physiology	VR + physiological sensors	Used in hospitals for anxiety/pain reduction during procedures
Heart	VR + heart rate sensor	Clinical anxiety treatment using biofeedback and exposure therapy
Heart rate, brain	VR + biofeedback (HRV, EEG)	VR games that adapt based on user's stress response
Breathing	VR + breathing sensor	Underwater VR game that uses breath control to navigate – encourages relaxation

Conceptual system architecture / flowchart for a Stress/Anxiety Monitoring and Management System using Wearable Sensors + VR/AR + Biofeedback Loop:

1. **User wears sensors and uses a VR/AR device.**
2. **User is exposed to 6 to 7 different situations (created by professional psychologists).**
3. **User observes the situations and his body/mind react to it.**
4. **Wearable Sensor Layer** collects biometric data such as:
    - Heart Rate (via PPG or ECG)
    - Heart Rate Variability (HRV)
    - Galvanic Skin Response (GSR) / Electrodermal Activity (EDA)
    - EEG (brain wave activity)
    - Optional: Blood Oxygen (SpO_2) and Blood Pressure (BP)
5. **Signal Processing Module** cleans and prepares the data:
    - Filters out noise
    - Extracts relevant features
    - Syncs signals in real-time
6. **Stress/Anxiety Classifier** analyzes the data using either:
    - A machine learning model (designed by expert psychologists and physicians) or
    - A rule-based system {designed by expert psychologists and physicians} (e.g., high heart rate + low HRV = likely stress)

- Also uses EEG, GSR, BP data for better accuracy

7. **Feedback Controller & Recommender** takes action based on detected stress levels:
    - Adjusts the VR/AR experience to calm the user
    - Recommends breathing exercises
    - Triggers guided relaxation content
8. **Immersive VR/AR App** responds dynamically:
    - Changes the virtual environment
    - Displays calming, stress-relieving content (e.g., nature scenes, meditative visuals)

Rough financials (ballpark breakdown)

1. Design & development : Design of whole system including psychological situations, measurement parameters, selection of measuring equipment, signal processing, analytics model, feedback and control, AR/VR system design : **₹ 35 lacs** (including psychologist's & physician's consultancy)

2. Wearable Physiological Sensors(clinical grade) : (Research-grade sensors: HR, HRV, EDA, PPG, skin temp, SPO2, BP etc) **: ₹ 30 lacs** (including import duties)

3. . VR Headsets & PC / Standalone Unit & PC-VR Setup : ₹ 10 lacs

3. VR Software & Biofeedback Integration :

Psious VR Platform (clinical-grade exposure therapy with sensors) : ₹ 5 lacs/year

4. Sensors + Software Integration & Support : ₹ 5 lacs

5. Miscellaneous including training : ₹ 5 lacs

Total : 90 lacs

Note : We can tailor the system by choosing components aligned with specific needs of the Army.