**Table 1:** Functional Requirements Table

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Needs | Requirement | Units | Range | Ideal |
| Continuous video | EEG signal capture, low latency | seconds | 1 second – 10 second | 4 seconds |
| Image Resolution | The quality image reconstruction | pixels | 128 x 128 | 128x128 |
| Inception Score | Grade of realism of image | unit-less | 4.5-7.5 | 6.5 |
| Total Protocol Time | Time needed to have an individual participant go through the training process | minutes | 5-30 | 10 |
| Nice to Have | Requirement | Units | Range | Ideal |
| Noise / Image Fidelity | Does the image look like what was thought of to an average observer | decibels/pixels | - | - |
| STL precision | Accurate 3D model reconstruction | Millimeters | 0.01-1 mm | 0.01mm |
| Video smoothness/logicality | Does the video look logical / smooth to a viewer | - | - | - |
| Open Source | All involved technology is open source | - | 0 – 2 closed source tools | 0 closed source tools |

**Table 2: Requirement/Verification Cross-Reference Matrix**

Classes of Verification: I- First Article, II-Environmental, III-Acceptance Test, IV- None

Methods of Verification: A- Analysis, T-Test, D-Demonstration, I- Inspection

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Project Requirements | Test Names | Verification Class | | | |
|  | I | II | III | IV |
| Video must be between 1-10 seconds long | Continuous Video | T |  |  |  |
| The resolution of the image is 128x128 pixels | Image Resolution | I |  |  |  |
| Inception Score must be between 4.5-7.5 | Inception Score | I |  |  |  |
| Training duration between 5-30min | Total Protocol time | T |  |  |  |
| Reconstructed image fidelity looks like what was thought | Image Fidelity |  |  | T |  |
| Video smooth to a viewer | Video Coherence |  |  | I |  |
| Used at most 2 closed source tools | Open Source | I |  |  |  |
| Precision of the 3D model is between 0.01-1 mm\* | STL Precision | I |  |  |  |
| Image generation code works | Coding Process (Image) | D |  |  |  |
| Video Generation code works | Coding Process (Video) | D |  |  |  |
| Stimulus presentation code works | Coding Process (Stimulus) | D |  |  |  |
| Recording EEG to video signal chain operates as intended | Coding Process (Overall) | D |  |  |  |

\*Only perform if project reaches that stage

* **Continuous Video**
  + **Purpose:** To ensure video has ample duration to be considered a “video”, deemed 1-10 seconds
  + **Rationale:** Having a video generated by EEG signals is the basis for this project and ensuring it is satisfactorily long enough critical.
* **Image resolution**
  + **Purpose:** To ensure that the system reconstructs images at the specified resolution of 128x128 pixels.
  + **Rationale:** High-quality image reconstruction is vital for accurately representing the EEG data in visual form. Meeting the specified resolution ensures clarity and detail in the generated images.
* **Inception Score**
  + **Purpose:** To assess the realism of the generated images using the Inception Score, targeting a score between 4.5 and 7.5, with an ideal of 6.5.
  + **Rationale:** The Inception Score evaluates the quality of generated images. Achieving a high score indicates that the images are both realistic and varied, enhancing the system's credibility.
* **Total Protocol Time**
  + **Purpose:** To measure the time required for an individual participant to complete the training process, ensuring it falls between 5 and 30 minutes, with an ideal duration of 10 minutes.
  + **Rationale:** Efficient training processes are important for user engagement and system usability. Keeping the training duration within the specified range ensures that participants can effectively use the system without undue time commitment and lack of comfortability leading to staler data towards later trials.
* **Image Fidelity**
  + **Purpose:** To determine whether the generated images appear as intended to an average observer.
  + **Rationale:** Subjective evaluation complements quantitative metrics by incorporating human judgment, ensuring that the images are not only technically accurate but also perceptually convincing.
* **Video Coherence**
  + **Purpose:** To assess whether the generated video appears logical and smooth to viewers.
  + **Rationale:** Smooth and coherent video playback is essential for user satisfaction and system effectiveness. This test ensures that the transitions and flow of the video are natural and comprehensible.
* **Open-Source**
  + **Purpose:** To confirm that all technologies used in the system are open source, with a tolerance of up to 2 closed-source tools, ideally aiming for none.
  + **Rationale:** Using open-source tools is one of Dr. LaRocco’s goals for this project to ensure future development and ease of adoption.
* **STL Precision**
  + **Purpose:** To verify that the system reconstructs 3D models with a precision between 0.01 and 1 mm, aiming for the ideal precision of 0.01 mm.
  + **Rationale:** High precision in 3D model reconstruction is crucial for Dr. LaRocco’s applications requiring detailed spatial representations, ensuring the models are accurate and reliable.
  + **Note:** This test will only be performed if the project is able to pass all tests with enough time left to develop this portion of the project.
* **Coding Process**
  + **Purpose:** To verify that each section (Image Generation, Video Generation, and Stimulus Presentation) of the code runs to completion with the required inputs and generates an acceptable output, if applicable. Then verify that the code runs in its entirety with no errors.
  + **Rationale:** If the code cannot run without errors, or produce a usable output, then the requirements of the project cannot be met.