

## Bioengineering Day Poster Addendum

### **1. Desired Needs**

One desired need for the project was ensuring the device could function across multiple subjects with varying physiological characteristics and neck anatomies. This motivated increasing optical power output and experimenting with sensor placement to increase signal consistency between users.

Another desired need was the ability to measure continuous changes in glottal aperture rather than only detecting binary open/closed vocal fold states during phonation. This led to the removal of a secondary gain stage that was believed to be saturating the signal, allowing for improved gradient-based signal detection.

### **2. Major Constraints**

*Physical Constraints:* The device must remain compact, lightweight, and wearable so that it does not interfere with natural speech production while positioned on the neck. Due to the limited placement area and variability of laryngeal anatomy between individuals, the design must account for neck curvature, motion during phonation, and proper alignment of the optical components.

*Safety Constraints:* The system must be safe for operation by users with minimal training since the current scope is primarily in linguistic research laboratories. Additionally, electrical components must not risk burn or shock to users.

### **3. Major Engineering Standards**

*FDA Medical Device Standards:* In future medical scopes, a non-invasive diagnostic monitoring device similar to a photoelectroglottography system would likely fall under the Class II medical device category, requiring demonstration of safety and effectiveness through a regulatory pathway such as FDA 510(k) clearance.

*Electrical Safety Standards:* IEC 60601-1 outlines safety requirements for medical electrical equipment, including protection against electrical shock, overheating, and device malfunction.

*Optical Safety Standards:* The device uses infrared light sources to transmit light through biological tissue. Standards such as IEC 62471 and IEC 60825 provide guidance regarding photobiological and optical radiation safety.

### **4. Ethical, Environmental, and Societal Concerns**

One ethical concern associated with the project involves the global sourcing and manufacturing of low-cost electronic components, which may involve exploitative labor practices or environmentally harmful resource extraction. Environmental concerns include the use of 3D-printed materials such as PLA and TPU, which, although generally considered safer plastics, are only biodegradable under specific industrial conditions and may contribute to plastic waste if improperly discarded. At the current stage of development, the project is not expected to introduce significant societal concerns.

### **5. Active Teamwork and Leadership**

Team communication primarily occurred through two group communication channels: a Google Chat including advisors and team members, and a separate mobile group chat used for internal team coordination. Leadership responsibilities and subprojects were delegated based on project needs and advisor feedback. The team established goals and deadlines through consistent communication and collaborative planning.

Constructive feedback was regularly exchanged regarding improvements to the placement mechanism, signal quality, and overall device functionality, allowing iterative refinements throughout development.

### **6. Motivating Factors**

A major motivating factor was the opportunity to contribute to a niche area of research with limited prior documentation and published work, as photoelectroglottography currently has relatively few research papers and patents. The team was also motivated by the goal of improving upon the previous year's prototype design while contributing to potential future applications in speech science and linguistics research.

### **7. Innovative and Entrepreneurial Ideas**

Although the current project scope is focused on linguistics research, one innovative direction would involve adapting the device for future clinical applications through collaboration with laryngologists and medical imaging specialists. Clinical validation could potentially involve comparisons against laryngoscopy, MRI imaging, or other established diagnostic techniques to evaluate medical relevance.

