GeneWEAVE™

www.geneWEAVE.com

UCSB EE Capstone Project

Next Generation Luminescence Detector

vivoDx™

GeneWEAVE, a division of Roche Molecular Diagnostics

A Silicon Valley company with headquarters in Los Gatos, CA, GeneWEAVE is taking on drug-resistant bacteria – modern medicine's biggest challenge. We use our novel Smarticles™ technology to build solutions that give healthcare providers around the world the tools they need to guide treatment and keep patients safe from the threat of bacterial infections.

Diego Rey and Jason Springs, two graduate students from Cornell University, founded GeneWEAVE in 2010. Diego received his BS in ECE from UCSB in 2000. CEO Steve Tablak, who is also a Gaucho, leads GeneWEAVE. In August of 2015, Roche acquired GeneWEAVE.

Headquartered in Basel, Switzerland, Roche is a leader in research-focused healthcare with combined strengths in pharmaceuticals and diagnostics. Roche is the world's largest biotech company and the world leader in *in vitro* diagnostics.

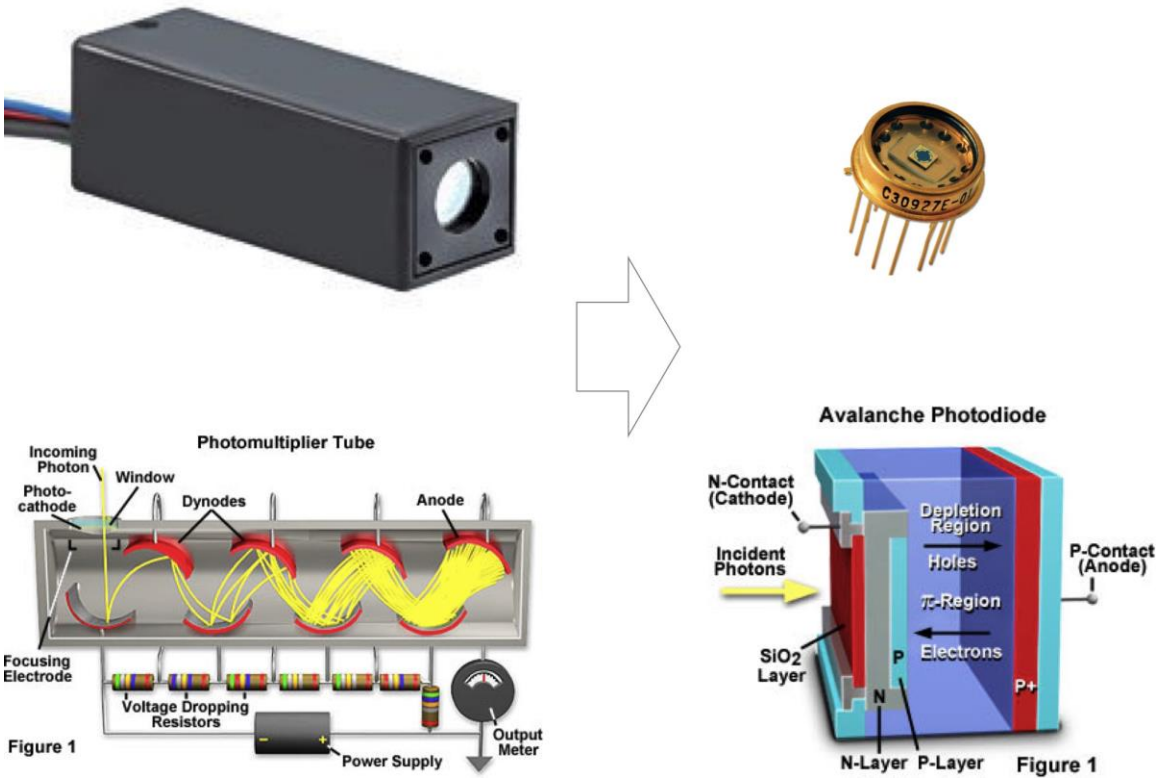

Figure 1 *Top left: PMT module (Edmund Optics); Bottom left: PMT design & function (Hamamatsu); Top right: APD module (Warsash Scientific); Bottom right: APD design & function (Hamamatsu).*

Project Description

GeneWEAVE has developed the vivoDx™, a fully automated clinical laboratory instrument that processes patient samples for pathogen detection based on a luminescence reaction. The vivoDx™ uses a photomultiplier tube (PMT) to detect light from the luminescence reaction.

PMTs are photoemissive devices in which the absorption of a photon results in the emission of electrons that are then amplified. They are useful in detecting very weak light signals and exhibit exquisite signal to noise ratios. PMTs are also relatively bulky and expensive. See: Figure 1 and http://ow.ly/S0fdo

GeneWEAVE is interested in replacing the PMT component of the vivoDx™ with a less expensive and less bulky alternative. Such a solution may allow GeneWEAVE to reduce the cost of the vivoDx™ and could also enable the development of new smaller devices such as point-of-care instruments.

One possible alternative to a PMT is a silicon photomultiplier (SiPM) device. SiPMs are solid-state devices capable of detecting single photons. They are composed of an array of avalanche photodiode (APD). APDs cause the excitation of electrons from incident photons and provide gain by the generation of electron-hole pairs from an energetic electron that creates an "avalanche" of electrons in a substrate. See: Figure 1 and http://ow.ly/S0jCx

The goal is to develop an alternative component to a PMT that results in a smaller and less expensive system that yet exhibits equivalent or better performance to that of the PMT-based system. Previous studies have demonstrated that SiPM-based systems may achieve this goal but that off-the shelf components exhibit too much noise and require direct integration with a cooling mechanism.

GeneWEAVE is seeking a team of creative and motivated UCSB students to take on this challenge and that would like to interact with a cutting edge clinical diagnostics company.

Project Scope

GeneWEAVE will provide a PMT breadboard that mimics the function and performance of the vivoDx™ system. The PMT breadboard will serve as the reference system whose performance will need to be matched or superseded by an alternative system. The Capstone team will be responsible for building and testing an SiPM-based reference system.

The team will then need to develop an alternative system that is at least 5-times less expensive, at least 5-times smaller, and yet exhibits the equivalent or better performance to the reference system.

Key design elements required on this project include:

- Consideration of the luciferase (i.e. bioluminescence) emission spectrum
- Minimum detectable photon flux (signal level)
- Research and analysis of possible solutions that take into account a holistic view of an integrated system and not simply an emphasis on the detection component
- Design of an alternative system within the bounds of the existing functional parameters of the vivoDx™ system
- Forecasting of final integrated system cost and size for meeting project goals

GeneWEAVE will provide guidance with regards to system requirements but will rely on the engineering expertise of the Capstone team and mentors.

Project Deliverables

The project team will deliver:

- One fully functioning prototype
- Documentation of system design history, experimental data, data analysis, final bill of materials, final schematics, and any other relevant documentation necessary to demonstrate system design and function such that an outside party may reproduce the system

Requirements

Team participants will be required to:

- Sign Confidentiality and Assignment Agreements that assign ownership of intellectual property that may be developed during the course of the project
- Obtain approval from GeneWEAVE before any public disclosure of materials or information relating to the project