Requirements Document

The Light Amplifying Signal Sensing Object

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Prepared By:	Dundee iGEM 2014
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1 Introduction

1.1 Project Description

1.1.1 Perspective

Current techniques for determining lung infections in Cystic Fibrosis patients focus on investigating bacterial load through laborious lab procedures that take between 72 hours to 2 weeks. The aim of the L.A.S.S.O is to work alongside a synthetically developed *E.coli* which can detect these bacteria in one hour. The *E. coli* will produce a bioluminescence in the presence of certain bacteria, the L.A.S.S.O. can read the light level to give a quantitative reading of the bacteria present.

1.1.2 Functionality

The L.A.S.S.O. will be able to give the user a quantitative display of the amount of a specified bacteria in a sputum sample. This will consist of the user inserting a plate consisting of genetically modified *E.coli* and a sample of sputum. The *E.coli* will produce bioluminescent light if the bacteria is present. The L.A.S.S.O. will detect this light using a photodiode, the voltage produced by the diode is then passed through an amplifying circuit. The amplified voltage is then passed to an Arduino Uno™ which is connected to the users computer. The user will have a companion application installed on their computer. The application will communicate with the Arduino and be able to record the voltages. Once it has this value it will compare it to a reading taken before the sample was inserted. The difference between these two readings is referenced against voltage ranges for given concentrations of bioluminescent output. Once the reading is complete the user will use a plunger to move the sample from the main compartment to a connected "bin" which will store multiple used samples before need to be emptied.

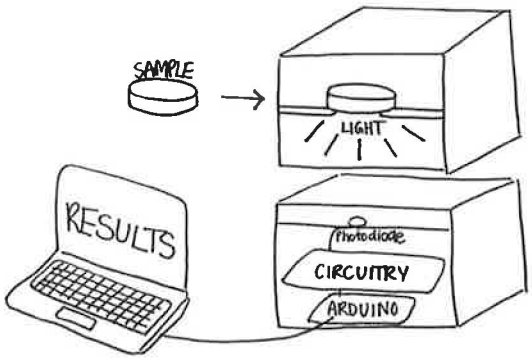

Fig 1: Basic functionality of L.A.S.S.O.

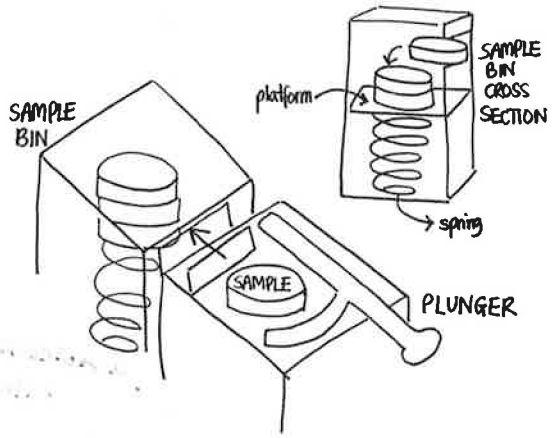

Fig 2: Moving of sample from main compartment to "bin"

1.1.3 Users

The L.A.S.S.O. will be used by medical staff on home visits to CF patients or medical professionals within CF clinics. It could also be used by patients themselves.

1.2 Points of Contact

1.2.1 Project supervisors - Dr. Fordyce Davidson, Prof. Tracy Palmer, Prof. Frank Sargent

1.2.2 Development team - Dundee iGEM 2014

1.2.3 User - Ninewells Cystic Fibrosis Clinic

2. Requirements Specification

2.1 Functional Requirements

Category	#	Requirement	Comment	Date Reviewed
Reading	**2.1.1.1**	Light level should be read from various *E.coli* samples.		
Quantifying Bacterial Load	**2.1.2.1**	The L.A.S.S.O. should test for the presence of Pseudomonas Aeruginosa, Stenotrophomonas Maltophilia and Burkholderia Cepacia.		
	2.1.2.2	By using methods of averaging with relation to the mean value theorem the device should get stable results.		
	2.1.2.3	Comparing the voltage produced by a *E.coli* sample with known voltages generated by specific bacteria concentrations it should be possible to quantify the amount of bacteria present in the sample.		
	2.1.2.4	The final voltage from the L.A.S.S.O. should be mapped to a low, medium and high concentration bacterial loads.		
Power	**2.1.3.1**	The L.A.S.S.O. should be battery powered.		
	2.1.3.2	The batteries should be rechargeable.		
	2.1.3.3	Batteries should be located externally with regards to the device in case of damage (eg. leakage).		

Safety	**2.1.4.1**	The L.A.S.S.O. should be safe to use within a clinic or patients home.		
	2.1.4.2	The genetically engineered *E.coli* should never come to contact with the user.		
	2.1.4.3	The waste compartment should provide an additional safety storage for the used plates.		
	2.1.4.4	The circuitry of the L.A.S.S.O. should be in a separate compartment to the *E.coli*.		
Certification	**2.1.5.1**	The L.A.S.S.O. should pass appropriate medical device certification. ✓	may not be necessary.	
Ergonometrics	**2.1.6.1**	The L.A.S.S.O. should be compact and light.		
	2.1.6.2	The L.A.S.S.O. should be stackable within the trolleys of medical staff.		
	2.1.6.3	The L.A.S.S.O. should be easily assembled from its constitutive parts.		
	2.1.6.4	The L.A.S.S.O. should contain the sample, electronics and waste compartment in separate sections to enable technicians easy access to each part for repair and maintenance purposes.		
Aesthetics	**2.1.7.1**	The L.A.S.S.O. should be visually appealing for the user.	desirable, but not essential.	

	2.1.7.2	The L.A.S.S.O. exterior should be light absorbing.		
Computer Application Graphical User Interface (GUI)	**2.1.8.1**	The application should display the bacterial load infection results to the user.		
	2.1.8.2	The application should be user friendly and simple to use.		
	2.1.8.3	The application should introduce the user to the functionality of the device with step-by-step instructions.		
	2.1.8.4	The application should run on computers with a Windows operating system.		
Email	**2.1.9.1**	An email should be sent to the clinic staff with the test results.		
	2.1.9.2	The email will be programmatically written and automatically sent.		

2.2 Non-functional Requirements

Category	#	Requirement	Comment	Date Reviewed
Quantifying	**2.2.1.1**	The mean value of the results should be within a 20% range of the upper and lower bounds of the data series.		
	2.2.1.2	Output voltages produced by the L.A.S.S.O. should be mapped to corresponding concentrations of luciferase produced by the *E.coli* in order to create voltage ranges for low, medium and high concentrations of bacterial load.		
Power	**2.2.2.1**	The L.A.S.S.O. should be supplied with external battery power at 9V.		

	2.2.2.2	The batteries should be rechargeable.	? fuzzier?	
Aesthetics	**2.2.3.1**	The coating of the exterior should reduce ambient light levels by a minimum of 80%.		
Computer Application Graphical User Interface (GUI)	**2.2.4.1**	The language used in the product will be English.		
	2.2.4.2	The user will interact with the application via a graphical user interface		
Safety	**2.2.5.1**	The L.A.S.S.O. should be serviced every 6 months.		