PRINTERIA

Collaborations

Hardvard: Fighting Stigma Against Synthetic Biology Report

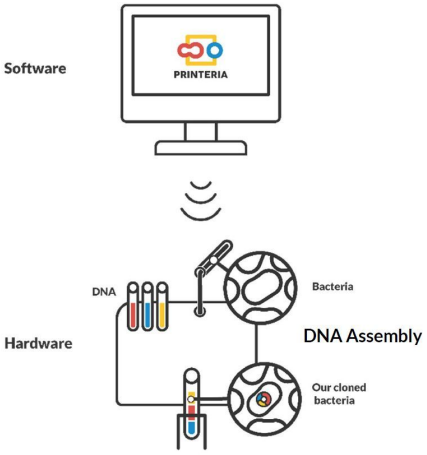
Report

First of all we have to explain to whom the survey is directed to. Only researchers, teachers and artists could fill out the survey due to the fact that they are the principal market segments according to MIT's market segmentation table. A total of 20 people filled out the survey.

The aim of our Valencia UPV iGEM project is to democratize the engineering of biological systems and, at the same time, to create a viable business model. Our challenge is to build up a fully-equipped bioengineering device able to execute lab protocols to modify bacterial chassis but made as simple and easy to operate as a domestic desktop printer, so everyone will be able to use it. Let us introduce you our simplified version of a biofoundry: Printeria.

How does Printeria work?

Printeria simplifies and optimizes Bioengineering by combining three defined areas that work together as a single one:



1. **Design Software**: Printeria is meant to be used by a wide range of users: from people who may not have any synthetic biology knowledge to scientific researchers in the lab. Due to this fact, it will use **an intuitive software** that includes different **graphic interfaces** oriented to different user profiles. Our software allows the user **to select** and **set** those sequences that need to be assembled, as if a puzzle was, to obtain a specific transcriptional unit (TU). Consequently, it gives the user the chance to build up a recombinant vector by using the present fragments of the collection, all this without having to install anything on their computer, with a **web-based application**. Furthermore, the users will be able to look up for new ideas in a **community**

repository and even share their own work. As a help, if a wrong assembly is done, the software will warn the user and provide theoretical information.

2. **DNA assembling:** The assembly system is based on the **Golden Gate Technology**, as it is a method that allows the highly efficient **directional assembly** of multiple DNA fragments in a single one-pot reaction, with no purification steps required thanks to the use of Type IIS enzymes. Printeria includes a **collection** of promoters, RBS, coding sequences and terminators domesticated in pUPD2 vectors with the Golden Braid 3.0 grammar. All parts are BioBrick compatible as well. With these parts, the user will be able to create different **transcriptional units** (TU) in the destination plasmid, so that many bacterial phenotypes can be achieved by the expression of these TU. We will also create different bacterial chassis, so Printeria will also allow the user to study more complex genetic circuits such as oscillators. The competent bacteria will be used in a **transformation** reaction with the assembled plasmids. The **negative selection** non transformed bacteria will be performed by using antibiotics whereas the **positive selection** of the transformed bacteria with the recombinant plasmid will be carried out including the **ccdB lethal gene** in the destination plasmids, as used in the Gateway technology.

3. **Hardware:** Printeria uses a **microfluidic system** that enables a discrete droplet to be manipulated through **configurable paths**, so that the assembly protocol is accomplished by mixing the substrates of the reaction as droplets. These drops are moved across cold and hot areas, controlling the time spent in each zone and the temperature of each phase. Finally, once bacteria have been transformed, physical measurements such as **optical density** and **fluorescence intensity** are taken to control the bacterial growth and the expression of a desired transcriptional unit with a fluorescent protein as a reporter.

Impact of Printeria on Society

- **Education:** Printeria is meant to be used to move synthetic biology closer to students in high schools. It will be programmed with an intuitive and didactic software that will allow students to design genetically modified bacteria and to explain them what steps Printeria is performing at a given time.

- **Museums and BioArt**: On the one hand, this "bacterial printer" could be used in public demonstrations of divulgative museums. By this way, not only students but everybody can learn about how a real cloning and transformation process takes place. On the other hand, the complexity of laboratory procedures may be an obstacle for BioArt artists, so Printeria could be used as a tool to make these procedures easier for them. Thus, our device eases the connection between art and science, as it replaces the necessity of an entire lab.

- **Research labs**: Printeria streamlines the steps followed in the bacterial cloning protocols, which are completely common in SynBio. Consequently, it allows the researcher to do other activities meanwhile, so it can increase the company's yield.