**Project Title**

# Primary contact for the team

Weiming Che ([wc289@cam.ac.uk](mailto:wc289@cam.ac.uk)), Control Group, Department of Engineering.

**Team**Please include the names and email addresses of all team members, include their department/organisation and briefly (1-2 sentences) what they will contribute to the project.

Zhengao Di ([zd250@cam.ac.uk](mailto:zd250@cam.ac.uk)), Department of Plant Sciences.

Weiming Che ([wc289@cam.ac.uk](mailto:wc289@cam.ac.uk)), Control Group, Department of Engineering. He will be in charge of electrical circuit integration as well as implementing control algorithms to modulate plant growth environment based on sensor readings.

**Summary [zd?]**

Summarise in one paragraph (~150 words) what you aim to do in the project.

# Proposal:

# The problem [zd]

The problem you are addressing…

**Biological systems [zd]**

The biological systems you are using…

**Hardware design goals**

The goal of hardware design is divided into two folds. The first is to integrate the sensors with the microcontrollers such as Arduino or Respray Pi. Light, temperature, humidity sensors will be applied to measure plant growing environments. In addition, we plan to use a camera to monitor the condition of the plants remotely. All data and videos will be logged and stored in a Cloud server through a WiFi module. The data can be reached and visualised on a web server upon request.

The other goal is to implement the control logic for the actuators, such as the lights, fan and water pump, based on sensor readings. We plan to apply PID controllers to keep the plant growing environment at a relative steady condition. An interrupt function will be embedded into the design to allow researchers reset the environment parameters and manipulate the actuators remotely based on their observation from the camera.

If time and funding permitted, we will also investigate the possibility of using robotic arm to achieve more accurate remote operations on the plants.

**Project implementation**

We plan to break the task into three stages. On the first stage, Zhengao will in charge of designing 3D models and ordering necessary components to build the plant growing chamber. In the meantime, Weiming will integrate the sensors with the microcontrollers as well as set up the communication channel between the micro controller and the remote server. This will take about two months.

On the second state, we will together assemble the plant growing chamber and mount the microcontroller, sensor and actuator system to the chamber. We will also write functions on the server to visualize the data from the sensors. This stage will take up another month.

Finally, on the third stage, we will together implement the automation algorithms to control the plant growing parameters. This will be an iterative design procedure and a test on the stability of the system will be carried on simultaneously.

# Outcomes and benefits [zd] The proposed outcomes and benefits…

**Sponsor for the work**   
Prof. Julian Hibberd

Head of Group;

Department of Plant Sciences, University of Cambridge

jmh65@cam.ac.uk

**List the components and budget that you envisage you will need to complete the project:** (see <https://biomaker.squarespace.com/ordering-information/> for more details and supplier list) The more detailed your bill of materials, the higher your proposal will be ranked so please include everything you think you will need to complete the project. There will be an opportunity to make alterations at a later date.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Item** | **Supplier** | **Catalogue #** | **Quantity** | **Price (each)** | **Total Price** |
| Camera |  |  | 1 |  |  |
| 3d printer |  |  | 1 |  |  |
| Lamp |  |  |  |  |  |
| Fan |  |  |  |  |  |
| Xxx module (for temperature control) |  |  |  |  |  |
| Material for 3d printer |  |  |  |  |  |
| Wires |  |  |  |  |  |
| Raspberry Pi |  |  |  |  |  |
| Breadboard |  |  |  |  |  |
| Thermosensor |  |  | 1 |  |  |
|  |  |  |  |  |  |

**The full application should be no more than 3 pages, excluding any figures, photos and diagrams which should be inserted at the end of the document and referenced in the text. There are no word limits on any section apart from the 150-word summary.**

**Please submit your complete application to** [**synbio@hermes.cam.ac.uk**](mailto:synbio@hermes.cam.ac.uk) **by 6th December 2020.**