

Pay-per-use concept for 3D printers

Section 1. Interaction Flow for using Pay-per-use concept

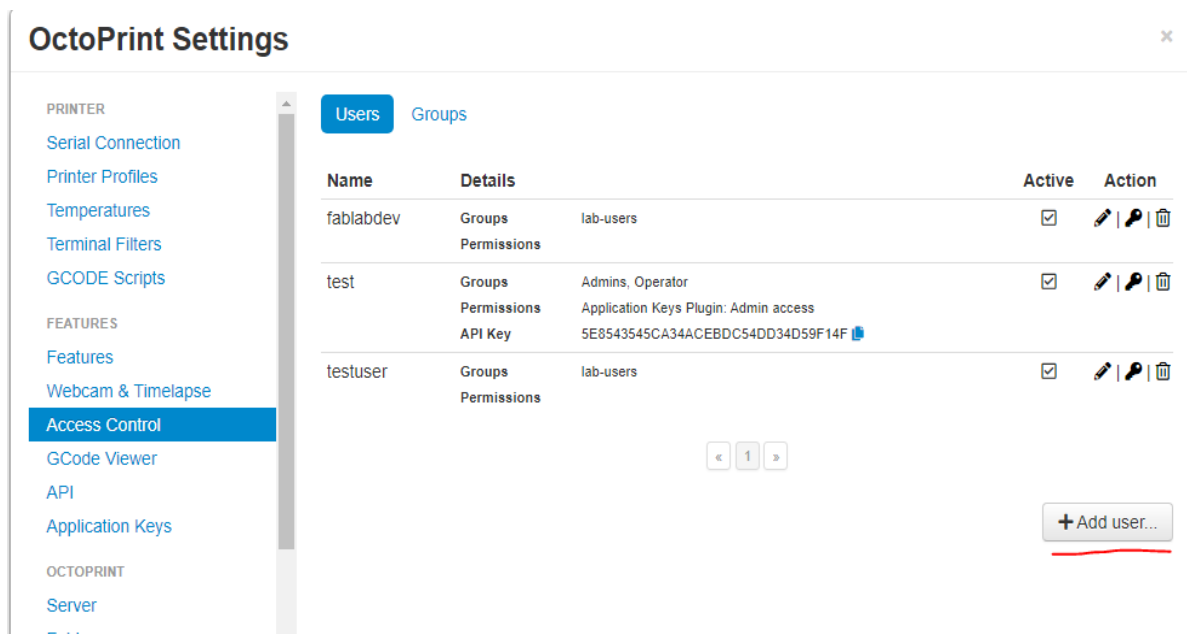
Customer: Visits lab to take a 3D print.

Operator: Ask the customer to slice the model using PrusaSlicer.

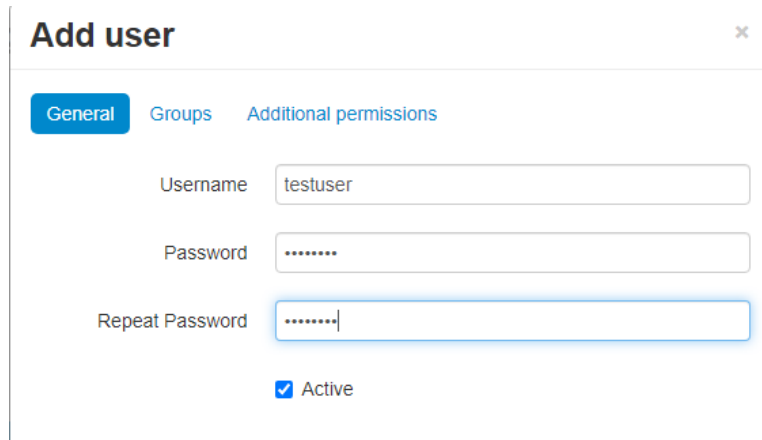
Customer: Slice the model in PrusaSlicer.

Link to download: <https://www.prusa3d.com/prusaslicer/>

Operator: Once slicing is done by the customer, Create a user account for the customer in the OctoPrint. Click on OctoPrint settings-> Access control -> Add user.



Operator: Provide customers with a username, password. (Note: Username should not contain spaces)



Add user ✕

General Groups Additional permissions

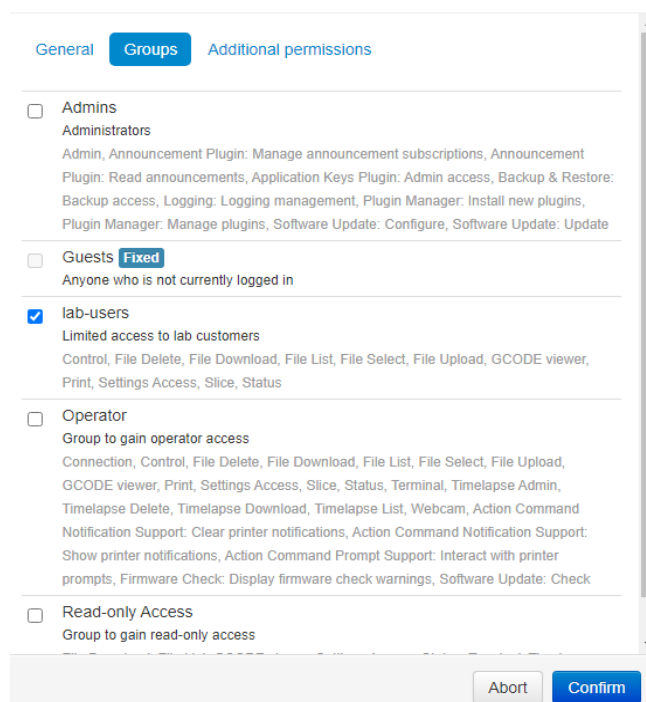
Username

Password

Repeat Password

☒ Active

Operator: For the user, under groups, assign the new user a group named 'lab-users', this group provides the user with necessary access to the printer. (How to create the group 'lab-users' is mentioned in the Section 4 of this document). OctoPrint user setup is done, provide the user with credentials.



General **Groups** Additional permissions

☐ Admins
Administrators
Admin, Announcement Plugin: Manage announcement subscriptions, Announcement Plugin: Read announcements, Application Keys Plugin: Admin access, Backup & Restore: Backup access, Logging: Logging management, Plugin Manager: Install new plugins, Plugin Manager: Manage plugins, Software Update: Configure, Software Update: Update

☐ Guests **Fixed**
Anyone who is not currently logged in

☒ lab-users
Limited access to lab customers
Control, File Delete, File Download, File List, File Select, File Upload, GCODE viewer, Print, Settings Access, Slice, Status

☐ Operator
Group to gain operator access
Connection, Control, File Delete, File Download, File List, File Select, File Upload, GCODE viewer, Print, Settings Access, Slice, Status, Terminal, Timelapse Admin, Timelapse Delete, Timelapse Download, Timelapse List, Webcam, Action Command Notification Support: Clear printer notifications, Action Command Notification Support: Show printer notifications, Action Command Prompt Support: Interact with printer prompts, Firmware Check: Display firmware check warnings, Software Update: Check


☐ Read-only Access
Group to gain read-only access

Abort Confirm

Operator: Each printer has a unique RFID card, assign the user with the available printer by checking the status of printers in the web application (Red: Inactive, Green: Active which means printer is printing). Provide the corresponding RFID card of the printer to the customer.



3D printers status +

#	Printer name	RFID	Assigned user	Assigned by	Last access	Status	Actions
1	EOS	123 56	akhil	test operator	13-12-2020 23:15:05		Edit

Operator: Click on edit and assign the printer as shown below by filling the username, full name and assigned by operator details.

(Note: Here the username should match the OctoPrint username created)



Printer allocation

Printer Name :	EOS
RFID :	123 56
Username :	<input type="text" value="testuser"/>
Full Name:	<input type="text" value="testuser"/>
Assigned by:	<input type="text" value="test operator"/>


[Update](#)


Customer: Now customer has RFID card and OctoPrint credentials. Open OctoPrint in the browser with credentials provided. The state is 'Offline' in the OctoPrint.

Please log in

☐ Remember me [Forgot password?](#)

Log in

 OctoPrint

 **State**

State: **Offline**

File:

Uploaded:


Timelapse: -


Approx. Total Print Time: -


Print Time: -

Print Time Left: -

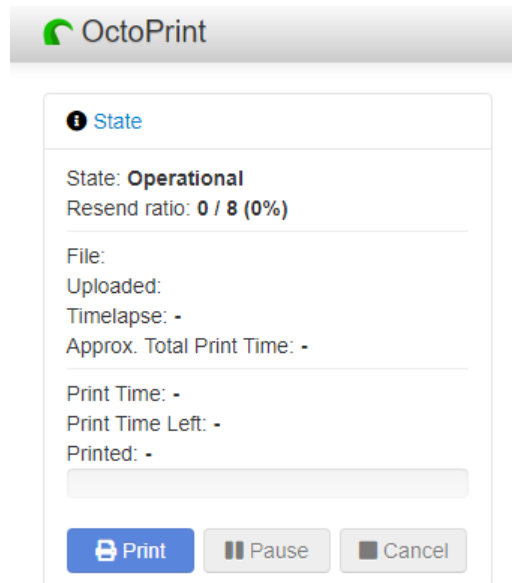
Printed: -

 Print

 Pause

 Cancel

Customer: Touch the RFID card provided by the operator to the microcontroller at the printer, this will connect the OctoPrint to the printer. Now in the OctoPrint, the state changes to 'Operational'.



Customer: Load the .gcode file to be printed in the OctoPrint, start printing.



State

State: **Operational**
Resend ratio: **0 / 8 (0%)**

File:
Cube_3d_printing_sample_0.15mm_PLA_M
Uploaded: **2020-12-04 03:52:37**
User: **akhil**
Timelapse: -
Filament (Tool 0): **1.50m / 3.62cm³**
Approx. Total Print Time: **9 minutes**

Print Time: -
Print Time Left: -
Printed: - / **1.0MB**

Print

Pause

Cancel

Operator: When the user start's printing in OctoPrint the Status in the web app turns green, showing that the printer is Active.


3D printers status +

#	Printer name	RFID	Assigned user	Assigned by	Last access	Status	Actions
1	EOS	123 56	testuser	test operator	17-12-2020 18:41:22	<div></div>	<div>Edit</div>

Customer: Once print is done, go to the operator, provide the details of filament used (in grams) from PrusaSlicer. You can know the filament used from PrusaSlicer at the bottom right as below.

Sliced Info	
Used Filament (m)	1.47
Used Filament (mm ³)	3536.01
Used Filament (g)	4.38
Cost	0.11
Estimated printing time:	
- normal mode	52m
- stealth mode	52m

Operator: Once print is done by the user, In the web application under usage details, the print details are available along with the cost details under 'Usage' page. Here Printer name is the printer which the operator has assigned to the user before step. Click on the 'View' option to just view the usage or 'Edit' option the usage detail to edit the usage.

<div>  Home <u>Usage</u> Maintenance Configuration </div>							
Usage details						Export	
#	Printer Name	Username	Print State	Time Stamp	Usage Time	Total Cost (€)	Actions
1	EOS	testuser	✓	17-12-2020 18:48:52	00:07:29	0.03	<div>View</div> <div>Edit</div>

Operator: By default, filament usage is not added to the print. It has to be manually filled by the operator. So, ask the user for the filament used or any additional usage. If present, add them to the usage as below by clicking on 'Edit' option the corresponding usage detail. Operators can select different filament types, edit the filament details and update them to the usage.

Overview

User:	testuser
File Name:	Cube_3d_printing_sample_0.15mm_PLA_MK3SMMU2S_49m.gcode
Print time (HH:MM:SS):	00:07:29
Time Stamp:	17-12-2020 18:48:52
Print Status:	PrintDone
Print Name:	EOS
Filament Cost (€):	0.13
Operating Cost (€):	0.01
Printer Cost (€):	0.02
Additional Cost (€):	0.00
Total Cost (€):	0.16

Edit Usage Details

Filament Type

Other

Filament price (€)

29,99

Filament weight (g)

1000,00

Filament used (g)

4,38

Additional cost (€)

0,00

Update

Operator: Update the edited usage detail to see the total cost of the print.

Operator: View page for the usage, contains all details of the print and its corresponding cost.


Overview

User:	testuser
File Name:	Cube_3d_printing_sample_0.15mm_PLA_MK3SMMU2S_49m.gcode
Print time (HH:MM:SS):	00:07:29
Time Stamp:	17-12-2020 18:48:52
Print Status:	PrintDone
Print Name:	EOS
Filament Name:	Other
Filament Price (€):	29.99
Filament Used (g):	4.38
Filament Weight (g):	1000.00
Filament Cost (€):	0.13
Operating Cost (€):	0.01
Printer Cost (€):	0.02
Additional Cost (€):	0.00
Total Cost (€):	0.16

Operator: Provide the user with the total cost (Euro) for the print.

Section 2. Default configuration setup

- Under the 'Configuration' page, the default values can be set for the printer and filaments. These details can be modified and updated. (Please be careful with the decimal values)
- For your information, the total usage cost of the print is based on these details.

 Home Usage Maintenance Configuration

Default configuration

Filament Details

Filament Type	Filament price (€)	Filament weight (g)
PLA	29,99	1000,00

Printer Name: EOS

Printer details


Printer price (€)	Lifespan (Hrs)	Maintenance cost (€)
780,00	5000	0,04

Operating details

Power consumption (kW)	Electricity Cost (€/kW)
0,20	0,25

Section 3. Maintenance details

- Under the maintenance page, you can see the remaining print hours for next maintenance. If the remaining hours are 0 which means that the printer needs to be serviced right away.
- Once the printer is serviced, then click on 'Reset' option to update that the maintenance is done. This will make the total printed hours to 0.
- If you want to change the service-interval, you can use the 'Update' option accordingly on this page.
- Note: The remaining print hours for next maintenance is difference of service-interval and total print hours printed by the printer).

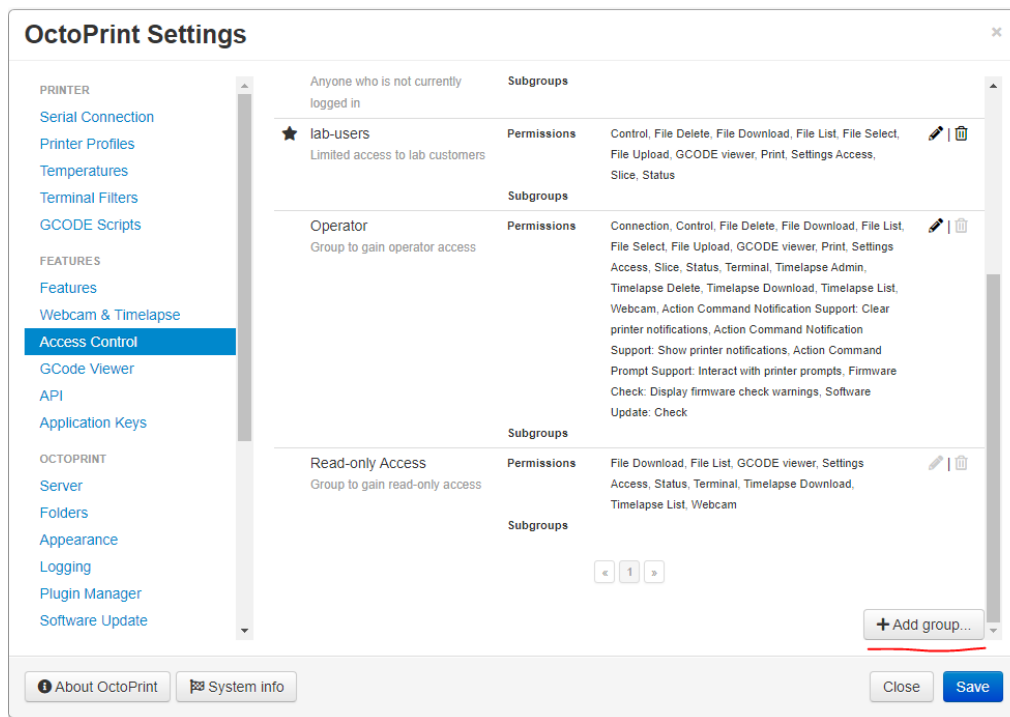
 Home Usage Maintenance Configuration

Maintenance

Printer Name :	EOS
Service-interval (Hrs) :	<input type="text" value="700"/> Update
Total Print hours :	4
Remaining print hours for next maintainence :	696
	Reset

Section 4. Creating user group in OctoPrint

- Open in OctoPrint, Under settings -> Access Control -> Groups -> Add group.



- Give a name, description for the group as follow.

The 'Add group' dialog box has three tabs: 'General' (selected), 'Permissions', and 'Subgroups'. Under the 'General' tab, there are two text input fields: 'Name' with the value 'lab-users' and 'Description' with the value 'To provide access to lab users'. Below these fields is a checkbox labeled 'Default' which is currently unchecked. To the right of the checkbox is a red 'Warning' label. Below the checkbox, a message states: 'Marking a group as default will make it get pre selected when creating new users.'

- Provide the following permissions to the group and click on confirm then save to create the group.

General Permissions Subgroups

☐ **Admin** Dangerous
Admin is allowed to do everything

☐ **Connection**
Allows to connect to and disconnect from a printer

☒ **Control**
Allows to control of the printer by using the temperature controls,the control tab or sending commands through the terminal.

☒ **File Delete**
Allows users to delete files and folders. If the File Upload permission is also set, File Delete also allows moving files and folders.

☒ **File Download**
Allows users to download files. The GCODE viewer is affected by this as well.

☒ **File List**
Allows to retrieve a list of all uploaded files and folders, includingtheir metadata (e.g. date, file size, analysis results, ...)

☒ **File Select**
Allows to select a file for printing

☒ **File Upload**
Allows users to upload new files, create new folders and copy existing ones. If the File Delete permission is also set, File Upload also allows moving files and folders.

☒ **GCODE viewer**

☒ **File Upload**
Allows users to upload new files, create new folders and copy existing ones. If the File Delete permission is also set, File Upload also allows moving files and folders.

☒ **GCODE viewer**
Allows access to the GCODE viewer if the "File Download" permission is also set.

☒ **Print**
Allows to start, pause and cancel a print job

☒ **Settings Access**
Allows to read non sensitive settings. Mandatory for the default UI to work.

☐ **Settings Admin** **Dangerous**
Allows to manage settings and also to read sensitive settings

☒ **Slice**
Allows to slice files

☒ **Status**
Allows to gather basic status information, e.g. job progress, printer state, temperatures, ...
Mandatory for the default UI to work

☐ **System** **Dangerous**
Allows to run system commands, e.g. restart OctoPrint, shutdown or reboot the system, and to retrieve system and usage information

☐ **Terminal**
Allows to watch the terminal tab but not to send commands to the printer from it

☐ **Timelapse Admin**
Allows to change the timelapse settings and delete or render unrendered timelapses.
Includes the "Timelapse List", "Timelapse Delete" and "Timelapse Download" permissions

Abort

Confirm

END