Design-Engineer Required to produce a **Fabric-Specific Laser Cutter**

Project Budget (Open to discussion) 12,500£ including materials (estimated at 4,000£) and excluding VAT

Project Duration 4 months

Start Date 10th May 2020

End Date 30th August 2020

Role Description
Person/s wanted for a project to make the maximum out of our budget of 12,500£ in the creation of a custom laser cutter for us for the pattern cutting of cloth. This will be to a very good, robust and reliable prototype standard and suitable for our trial evaluation in the retail environment. Total project duration is 4 months, and we estimate the work to be 4-6 person-weeks total, not under deadline stress. All IP (not that we anticipate much) to remain with us.

The skills we are looking for are hard engineering skills in precision mechanical, build, mechanical CAD, CNC, laser, optical, software (LaserGRBL C#), firmware (grbl C++), steppers, stepper drivers, air extraction and filtering, electrical and power supply etc. Some form design skills are a bonus, but we expect to work closely with you on the form and presentation suitable for the retail environment. Documented experience building one or more custom CNC machines would be a great asset.

Objective
The objective is to make an engineering prototype laser cutter (with a view to replicating it in small quantities) explicitly for the cutting of clothes patterns in cloth in a retail environment. The engineering standard should be well beyond MVP, and instead robust enough and presentable enough for regular daily use and good quality evaluation in several test retail environments but without the ‘bells-and-whistles’ features listed in item 16 below.

The timelines are 10th June 2020 for finalised drawings and concept test and 10th August 2020 for finalised delivery. Bearing in mind the supply risk factors, we would like to make a rapid start and address any engineering risk factors early on (e.g. laser power). The budgets for this prototype are fixed (as they are agreed with the funder) and the project features and costing should be designed in such a way, and negotiated with us, so as to easily fit within the budget including allowing for contingency.

Specifications

This laser cutter needs to:

1. Support easy and fast cutting on all kinds of cloth, in particular, natural and synthetic fabrics for pattern cutting on a bed size of approximately 1500x800mm.
2. Have a fairly quick two-dimensional cut speed of say, 400mm/s. Z-axis movement can be restricted to focusing only.
3. Preferably use a (probably 445 nm) laser diode or fibre laser, rather than a CO2 laser tube, for portability, easy alignment and physical robustness. Products from the Russian supplier, 'Endurance', should be investigated for suitability.
4. Be portable and robust enough to cope with regular travel between retail sites. This could, for instance, be accomplished with a light and stiff torsion box design for the base in plywood with all control electronics, extraction etc mounted in a Peli Case and connected by 'umbilical' containing all cables, extraction tubes etc. 'Portability' implies ease of set-up and teardown, physically compact and light for transport, wheeled for easy movement, and robust enough to cope with being transported and easily set-up without extensive optical alignment.
5. Be an elegant form suitable for use in a retail environment rather than a factory and preferably with an interesting and exciting physical presentation to encourage customer interest and engagement.
6. Have full laser protection, both for the user, customer and bystanders and suitable for the retail environment. This should be accomplished while preserving the retail experience as much as possible.
7. Have a vacuum bed to hold the cloth flat and simple air extraction and filtering to restrict the emission of smoke from the cutting process and make the cutter suitable for use in a retail environment.
8. Have standard homing, lid detection, E-stop and power switches (the latter preferably a key-switch) and simple LED illumination of the cutting area.
9. Allow both near-full-power through cuts and lower power / pulsed 'engraving' marking of instructions and pattern lines.
10. We anticipate we may need air/nitrogen / co2 assist to reduce effects of charring and reduce risk of fire.
11. Use easily obtainable components where possible (except probably for the base and cover) including steppers, belts, pulleys, rails, lead screws, bearings, profile and stepper-driver electronics etc.
12. The machine doesn't need to be hugely accurate and instead of the typical 0.1mm claimed accuracy of most laser cutters, we only require +-1mm accuracy.
13. Be built in a modular and pluggable manner so that most machine breakdowns can be addressed using simple component-swap techniques.
14. The driving software should be open-source and probably use GRBL firmware and LaserGRBL software. The latter should be modified (as an agreed interface) to accept either our SVG or G-Code patterns.

15. An API is needed (with example scripts preferably in python) to accept the following commands
    Initiate - Laser calibration and set up
    Cut shape - Receive and svg or image and cut with correct speed and power (multiple speed and power per file)
    And return with appropriate messages for success and errors and status when pinged
16. All aspects of safety should be addressed in a best-efforts manner including electrical, laser, mechanical, fire, air quality etc. The machine should be suitable for PAT-testing but at this stage, as it is a prototype, does not need to be prepared as part of this project for UK or EU CE marking, EMC/EMI/safety testing or certification.
17. These features may be ignored for now but borne in mind for a future version of the cutter (additional budget)
    1. cloth transport from the roll,
    2. easy cloth changeover,
    3. automatic laser focussing,
    4. active monitoring of emission air quality,
    5. action monitoring of cutting and danger of combustion/fire together with alarm/auto fire suppression (e.g. CO2).
    6. lighting, sound, UI etc. effects to enhance the customer experience
    7. a simplified software stream for pinking, annotation and pattern line marking, nesting etc.

Testing
Python script initialises laser cutter
Python script sends file (.svg) of apparel (with multiple speeds and power) to the laser cutter (we will provide .ai file)
Apparel is cut and marked within 3 minutes
Python script receives task finished signal

Deliverables
1. **Full-Scale laser cutter**
2. **Accompanying documentation**
3. **Example scripts to use API**

Response Format
Please send a 1-2 page proposal covering the points below by the 30th of April to simon@hetco.io. For any questions or clarifications - please call on +44 7715239211 between 10 am and 5 pm - Shruti.

- Project plan - how would you approach the work & your method
- Expected challenges & mitigations
- Outline of costs & delivery timetable

- Share examples of relevant projects, skills and expertise of your team

Additional Information

Possible project plan

	Tasks
	Concept Test
ii.	Make simple safety screen from polycarbonate.
iii.	Test on range of cloth samples using multiple passes & slower speeds if necessary.
iv.	Evaluate gantry mechanics for simple cut area expansion.
v.	Evaluate open source software & electronics for safety.
vi.	Evaluate need for air/nitrogen assist; fume exhaust and filtering; and requirement for cloth transport.
vii.	Do detail design of API.
viii.	Check software licensing requirements.
ix.	Develop firmware api, test and debug & amend as necessary.
Development - 1	
x.	Do engineering and form design of full-size version.
xi.	(a) Specify & buy in all components.
	(b) build torsion box base with well for honeycomb and provision for vacuum work holding / fume extraction
	(c) make polycarbonate cover
	(d) build new gantry with (i) adaptors for existing laser head, (ii) provision for manual Z adjustment; (iii) provision for air assist; (iv) new steppers and belt drives for X and Y; (v) new homing & Estop switches.
	(e) modify electronics to suit new gantry (parallel Y steppers)
xii.	Re-write firmware and controlling software if required for licensing or quality reasons.

xiii.	Build vacuum table / air (or nitrogen) assist / exhaust / fume filtering.
xiv.	Install all electronics etc into external wheeled Peli-case or similar.
xv.	Test and debug all software, electronics, mechanical etc.
	Analysis & Testing
xvi.	Perform extended evaluation with low volume manufacturing and make design notes for v2.
	Development Phase 2
xvii.	Perform extended evaluation with low volume manufacturing and make design notes for v2.