ALFRED BOWLES

PORTFOLIO

# Kwaee - La Biennale Di Venezia 2023
Xylotek
Computational Designer
Venice ; London | May 2023 | 6 Months
Built.

The central pavillion at the Biennale di Venezia 2023, Kwaee takes the form of a triangular prism. The 13m tall sculpture merges doorway, platform, assembly, and window into a single, unified entity. The sculpted internal space emerges as a distorted ovoid that punctures the form to create a canopied passage for entry and exit two oculi at the north and south elevations. By minimizing solid surfaces, the all-timber structure cultivates a forest of light and shadow, creating an immersive, cave-like atmosphere.

• In 6 months, using data-driven design methods, I took this project from conceptual design through fabrication and install.
• Using grasshopper and python and a rigorously organized workflow, geometric data was used to create 3513 bespoke timber beams, 2100 parametric flitch plates, labelled and organised cutting machine files, sequencing drawings and install animations.
• Played a key role in the logistics, transport, coordination and install of the pavillion in the Venice Arsenale.
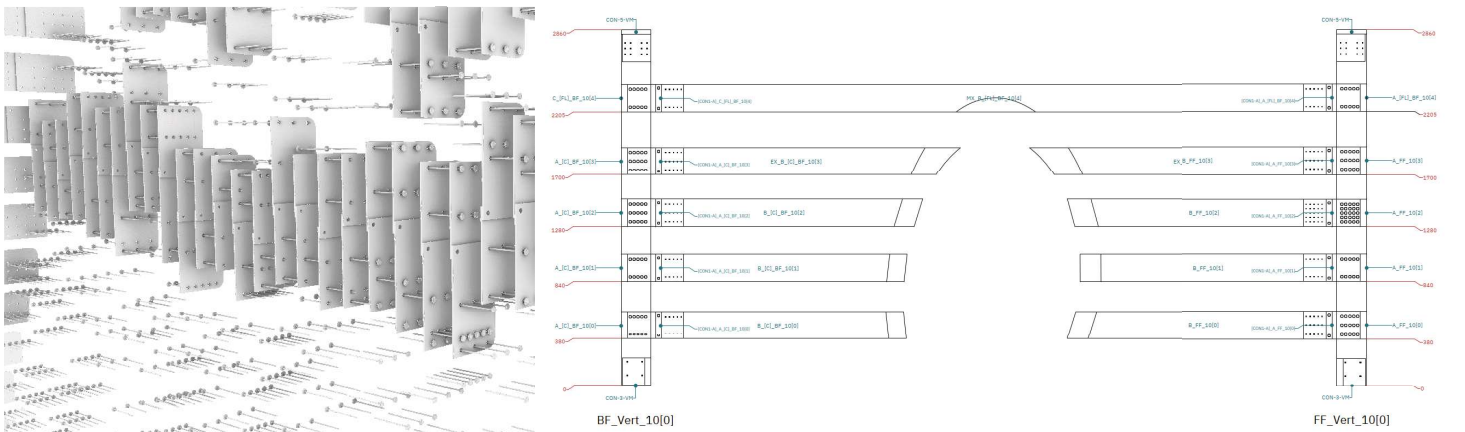
Bionic Bar
Makr Shakr
Project Manager
Italy ; Germany ; Spain ; China ; New York ; France | July 2021 | 3.5 Years
Built (x4).

The Bionic Bar is a robotic bar installation which uses two 6-axis robotic arms to create an infinite number of cocktails by mixing, shaking and pouring different liquors, juices and garnishes being ordered by a client facing mobile application.

• Project Manager in charge of the installation of the Bionic Bar aboard the largest cruise ships in the world.
• Integrated robotics, electrical power and data systems, PLCs, water supply, pneumatic air supply, refrigeration, juice/soda delivery and aesthetics as well as peripheral mechanical components in order to create the Bionic Bar.
• Managed teams of 15 people from 3 different contractors, while having to create daily plans, manage logistics, and solve daily technical and organizational problems while adhering to strict naval specifications.
• Managed the project budget and costs, achieving an average of 22% profit on each project.
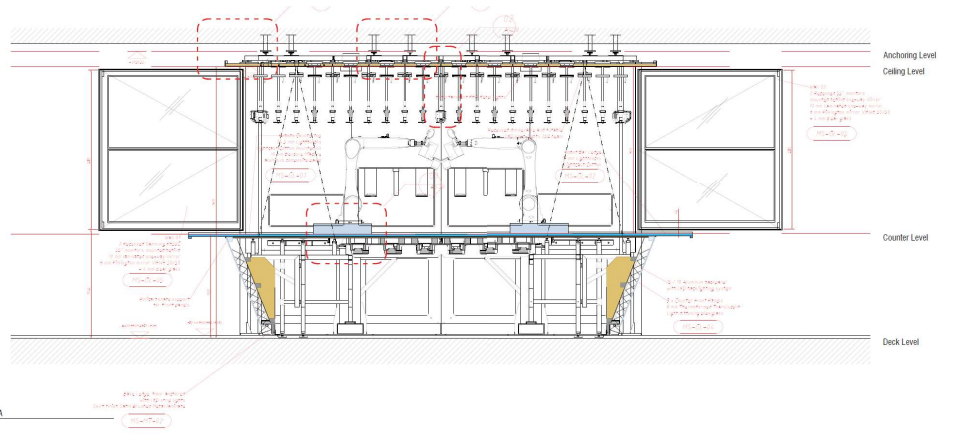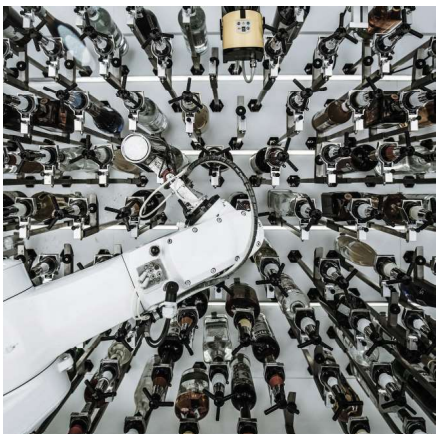
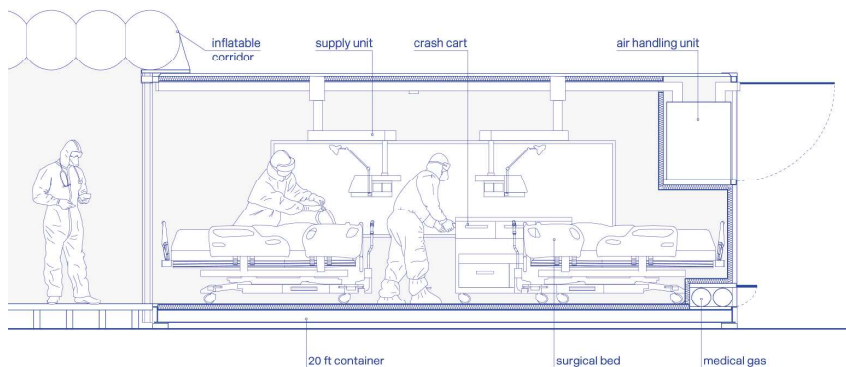# CURA | Connected Units for Respiratory Ailments
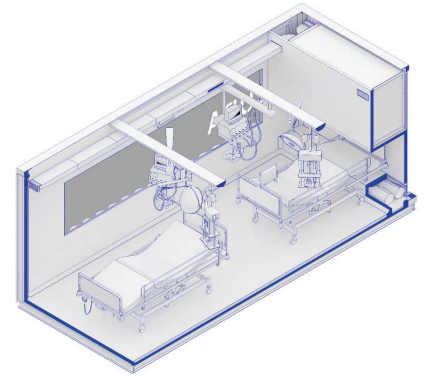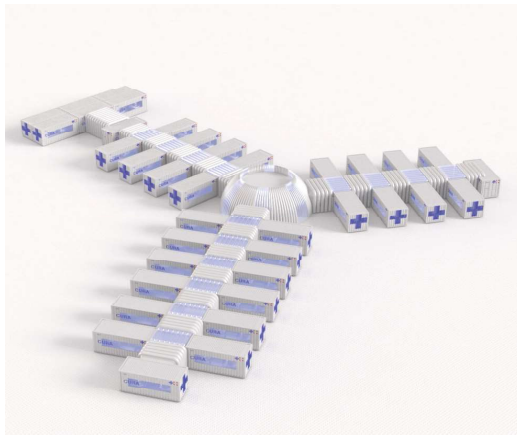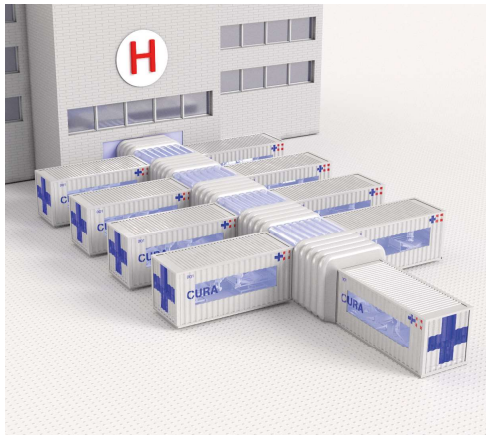## Carlo Ratti Associati
Designer / Fabricator / Engineer
Turin, Italy | March 2020 | 6 Weeks
Built.

CURA was an open-source project designed and executed in under a month in response to the 2020 Covid-19 pandemic. The goal was to create bio-containing ICU units made from shipping containers to be easily deployed in different areas around the world. The containers contained 2 ICE beds, each with their respective medical equipment (respirators, IV, ECG monitors..), as well as medical gas supply for O2, air and vacuum. An HVAC system was installed which created negative pressure inside of the container, keeping the virus isolated from the external environment, while air expelled from the containers was treated with an absolute filter. The first container was deployed at a pop-up hospital in Turin, Italy.

• As time and human resources were low, I had to fully design the container and executable drawings in under 2 weeks.
• Fully involved with the hands-on construction, including metal shaping & welding, paneling, and installation of the first unit.
• Part of the on-site deployment and installation team of the first unit in a pop-up Covid-19 hospital.
• Developed a complete BIM model on Revit which was then made open-source.

inflatable corridor | supply unit | crash cart | air handling unit

20 ft container | surgical bed | medical gas

Coaxial Motorized Shutters
## Carlo Ratti Associati
Project Lead / Engineer / Designer
Parma, Italy | March 2021 | 6 Months
Built.

The 6m high automatic swinging shutters are made of large horizontal strips of Oak and are installed at a Villa in Parma, Italy. With the constraint of having to completely hide the motors from view, the idea was to design a co-axial motor drive housed in an underground box which would deliver power to each of the upper doors and allow for each door to rotate independently. While the outside faces of the doors were made of Oak, the insides blended seamlessly with the the interior walls by integrating a white Alupanel sheet into the design.

• Project Manager, in charge of design, manufacturing and installation.
• Designed custom parts including bearing supports and motor boxes with our in house 3-axis CNC milling Machine.
• Coordinated between structural consultants, contractors, woodworkers, electricians and suppliers.
• Managed material and tool sourcing, worksite planning, coordination, assembly and installation.
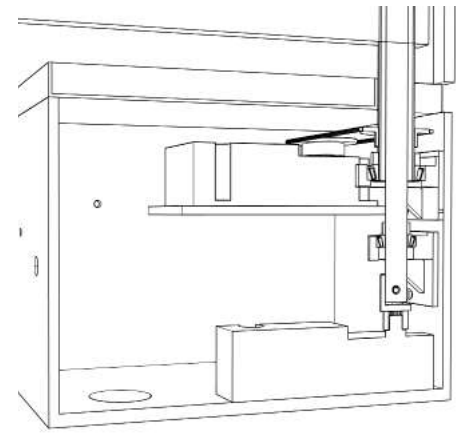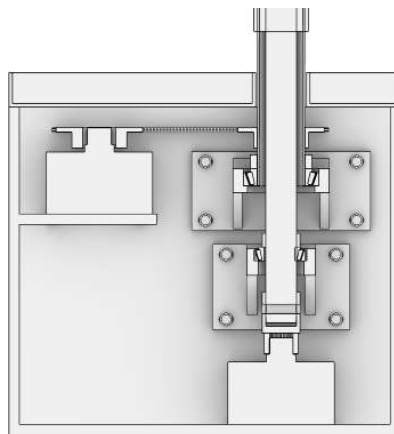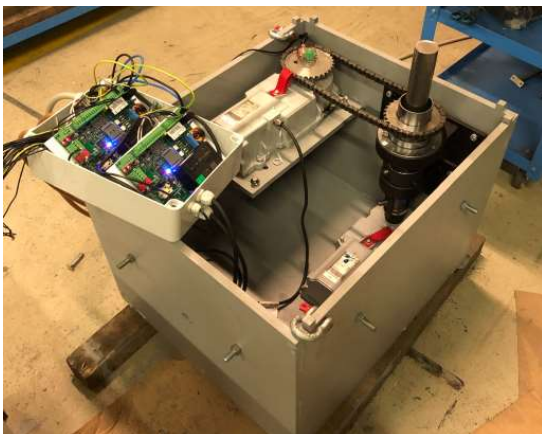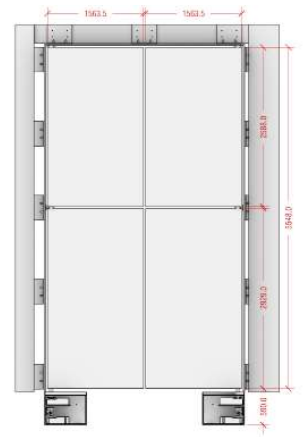
# Circolo - Robotic Bar
Makr Shakr
Project Lead / Designer / Engineer
Turin, Italy | September 2019 | 6 Months
Concept.

A prominent American casino chain looking to serialize its drink production, commissioned us to develop a bar which, opposed to our current bionic bar, delivers drinks at a high throughput of around 1 drink / 10 seconds. Production rate, cost and cocktail constraints led us to develop a conveyor-belt system which would create several drinks in serial bursts and deliver them to a tray for the waiters to simply pick up and deliver to the customers.

- Designed & engineered the system.
- Simulated production time.
- Developed the business plan and ROI for the client.
- Researched and contacted potential suppliers.
- Created the presentation deck and presented them to the client.
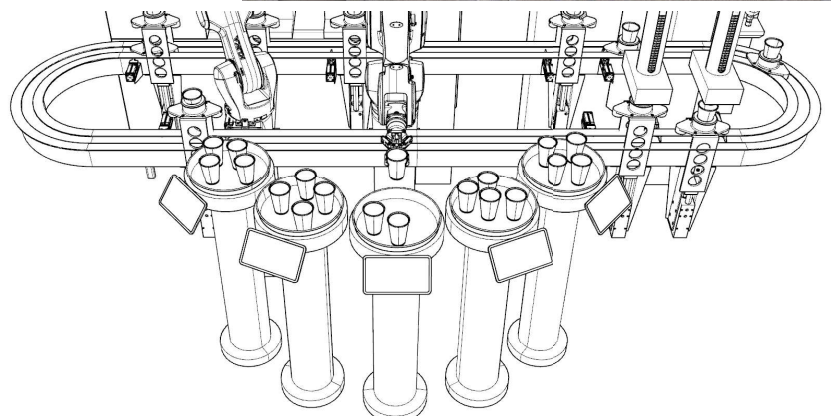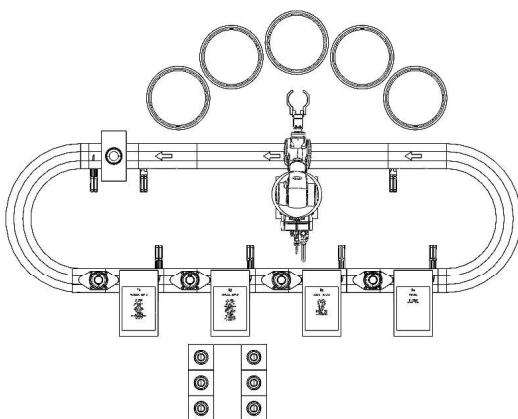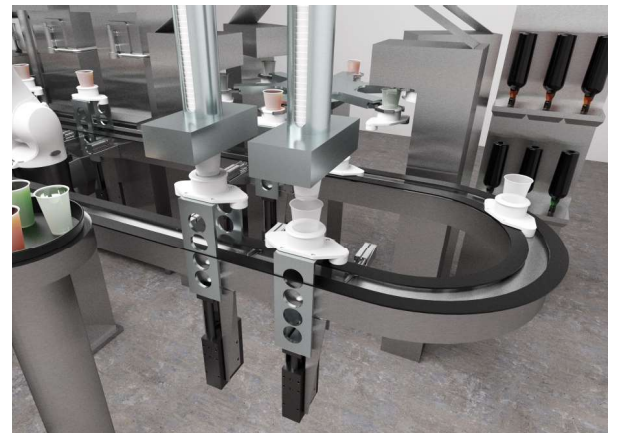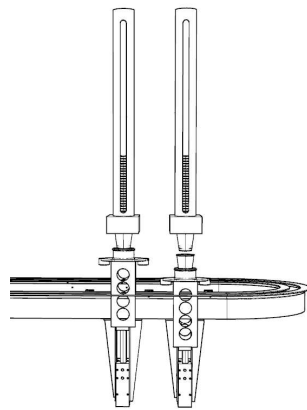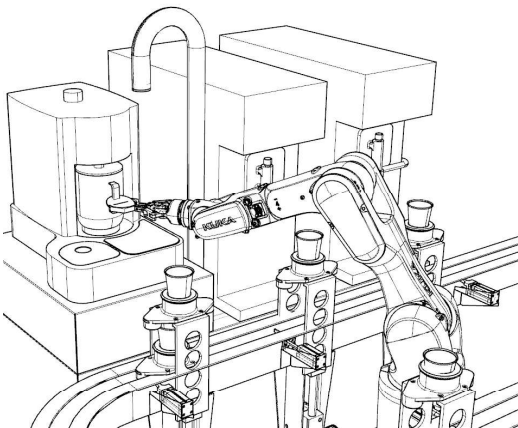
Decoded Disorder
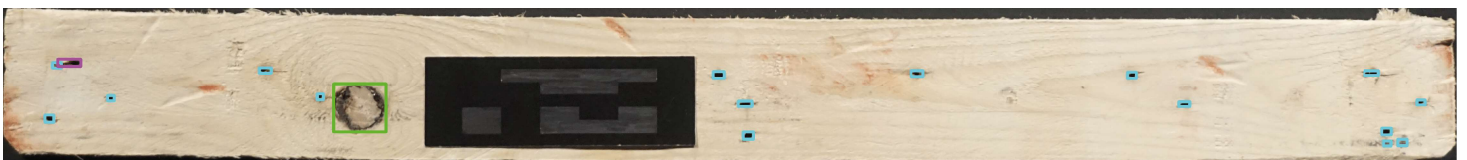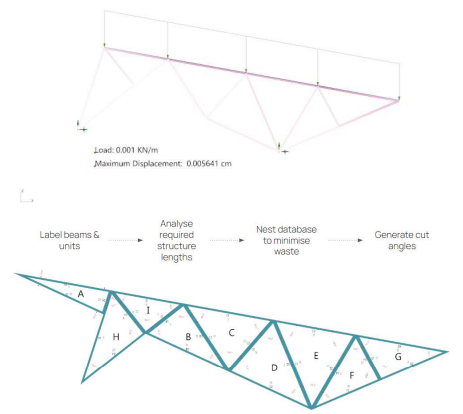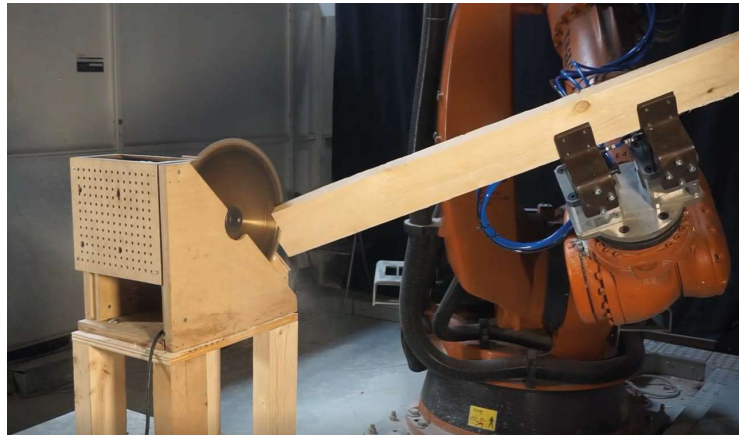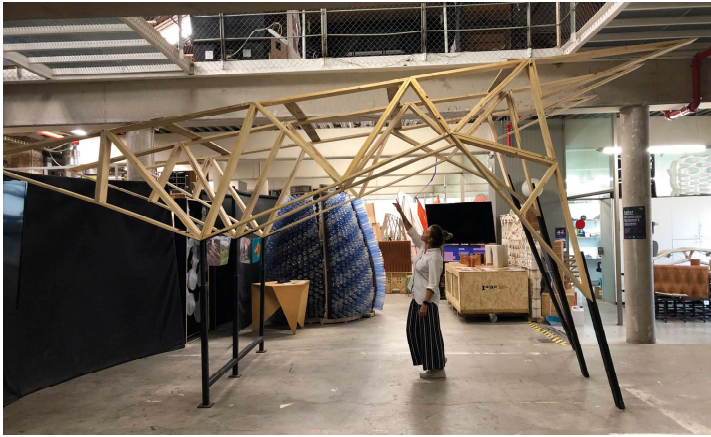## Institute for Advanced Architecture of Catalonia
Student
Barcelona, Spain | June 2022 | 2.5 Months
Prototype & Study.

In this project, we aim to explore the possibilities of a scalable waste material to design workflow and how irregularities in waste material could be intelligently used as an advantage in the design process by using adaptive algorithmic workflows. We propose a system for planar wood reuse where each recovered wooden plank is scanned using an RGB camera and rated based on its visual defects and then graded by a pre-trained neural network. After generating an algorithm to use each piece of wood in the most efficient manner in our design, we use a Kuka irb150 to cut a defined miter joint into each piece with a circular saw at a precise angle and place it into optimized triangular units which are then assembled to create our desired design.

• Created a robotically manufactured prototype made from scanned planar wastewood collected from dumpsters in Barcelona.
• Used computer vision & ML to scan & identify wood surface features and categorize them into a meaningful database from which our design was generated.
• Developed an algorithm to generate wood cutting angles minimizing waste and a parametric robotic toolpath to pick, cut and place each wooden plank.

Robotic Strip Bending Workshop
Institute for Advanced Architecture of Catalonia
Student
Barcelona, Spain | January 2022 | 1 Week
Robotic Study.

Moving from design, where every shape is possible, to fabrication where real world factors come in to play fabricability becomes an important parameter. One method for cost-efficient production of doubly-curved surfaces is the developability of planar material into curved surfaces. In this workshop we developed a grasshopper script utilizing physics simulations (Kangaroo 2), where several geometrical constraints force a real time deformation to maintain the properties of a developable strip. The resulting strip is discretized in planar quadrilaterals and a script is developed to generate the crease lines for kerfing on a CNC Machine and well as a robotic fabrication script to bend the strip to the desired angles accounting for springback in order to create the developed strips which were assembled and hung with LEDs as a lighting installation.

• Used the Kangaroo physics engine to approximate a flat strip into a doubly-curved developable strip.
• Performed structural analysis in Karamba3D to determine the optimal anchor points in order to minimize deflection.
• Developed a Grasshopper script to generate a parametric robot toolpath to pick, place and bend the different strips.
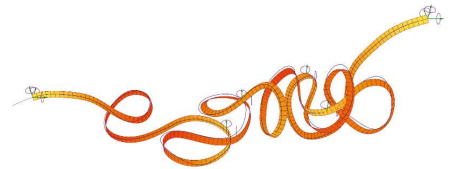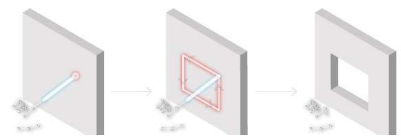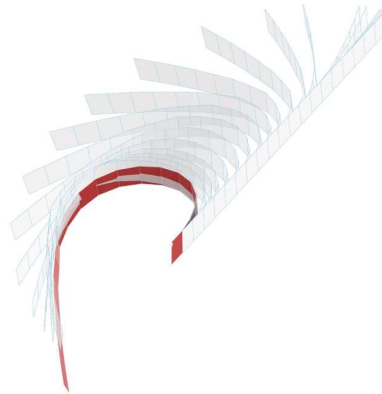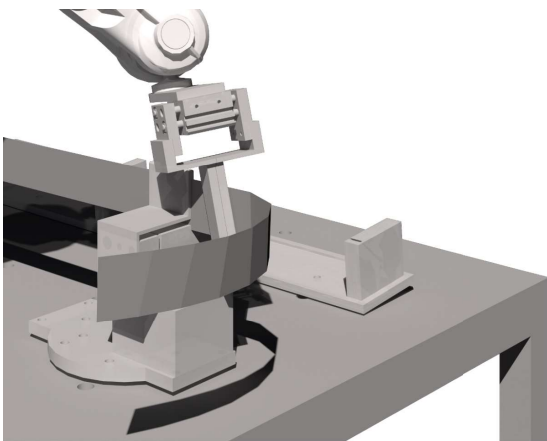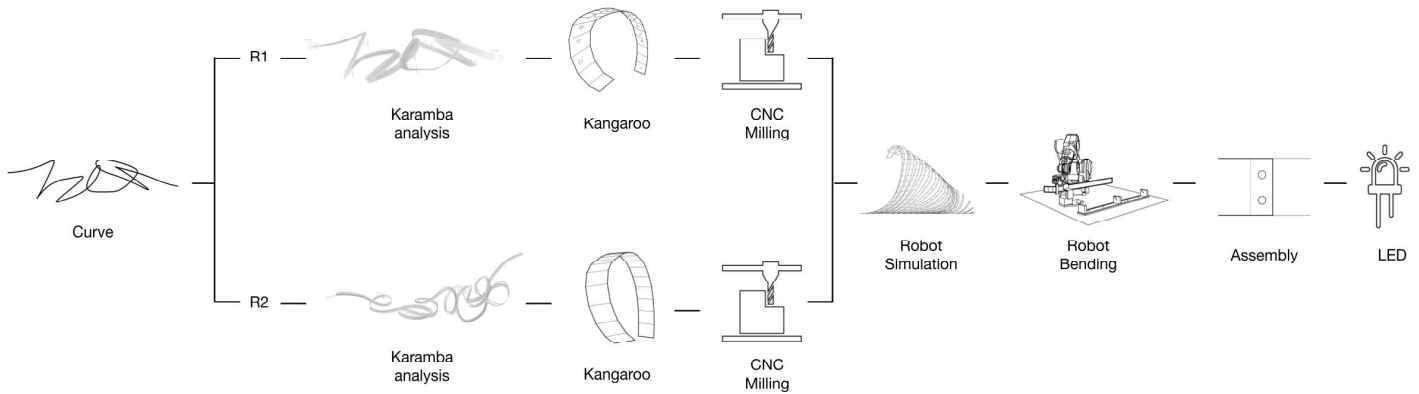
Frebujar - Handheld Milling Machine using Computer Vision
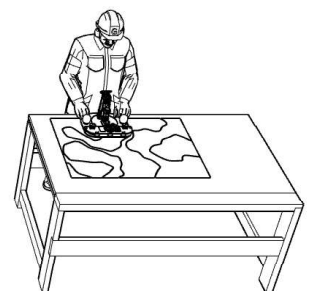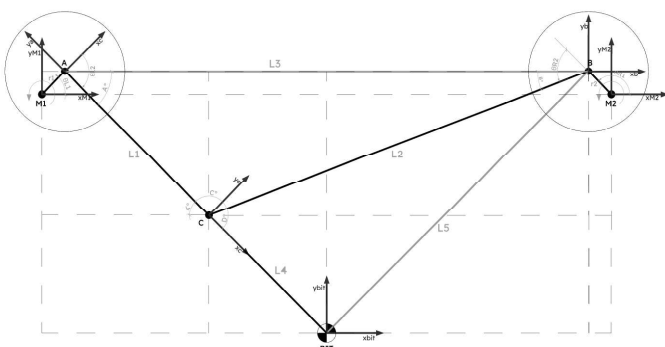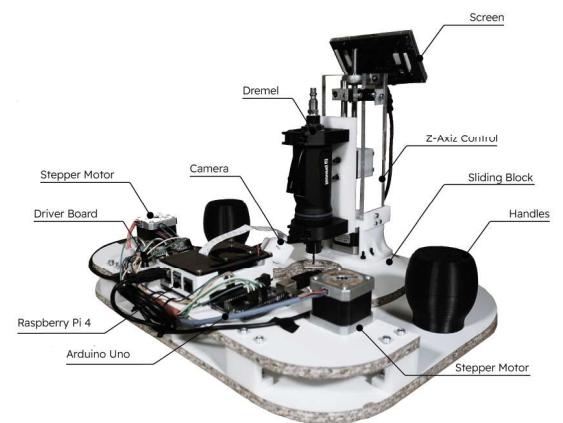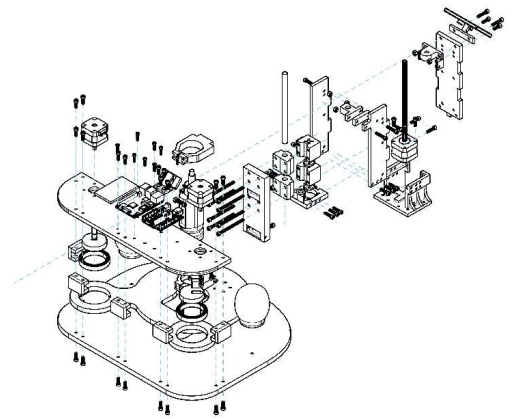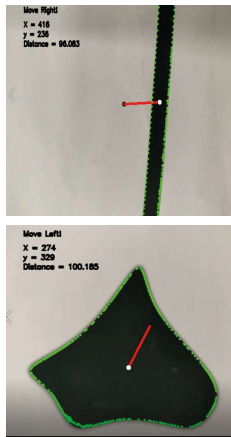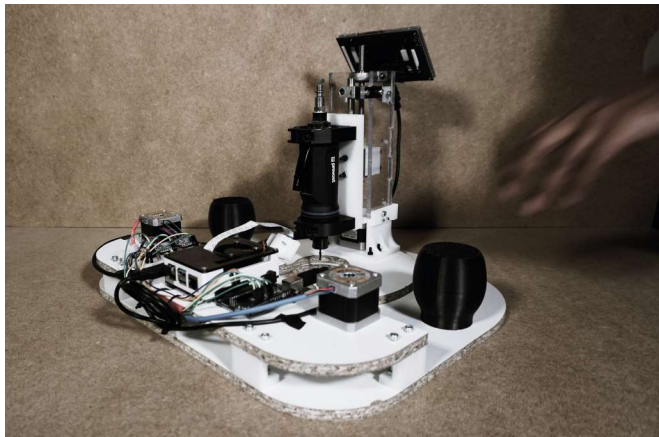## Institute for Advanced Architecture of Catalonia
Student
Barcelona, Spain | February 2022 | 2 Months
Study & Prototype.

The project aim was to develop a handheld CNC router which could be used for milling and inscribing into planar sheets of material. The user would either print or draw the desired pattern to be routed onto the piece of material. He would then activate the router and manually guide it over the material approximately following the printed path. The mounted camera which is aimed at the region around the bit tip will detect the dark regions using computer vision (OpenCV) and calculate the deviation needed to be made to account and correct for the user error and order the motors to move the mill head to the calculated point so as to only remove the dark regions. As the user progresses through the material only the black areas which were printed or drawn will be removed and the piece would be accurately milled.

• Rapid design, prototyping and fabrication using 3D printing, 3 axis milling, laser cutting and manual assembly.
• Inverse kinematics analysis in python of a 5 link mechanism and stepper motor with arduino.
• Image processing, masking, contour detection, homography and area calculation using OpenCV on RaspberryPi.

(Dis)Occupancy
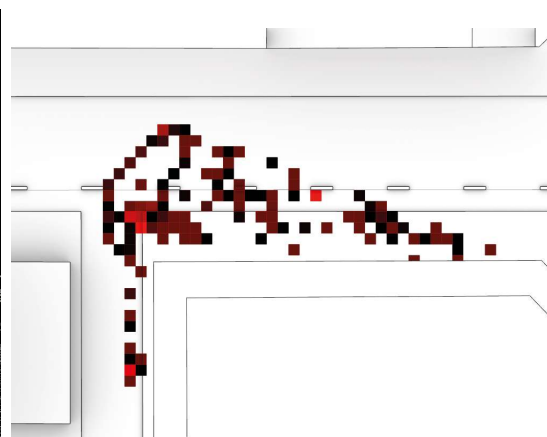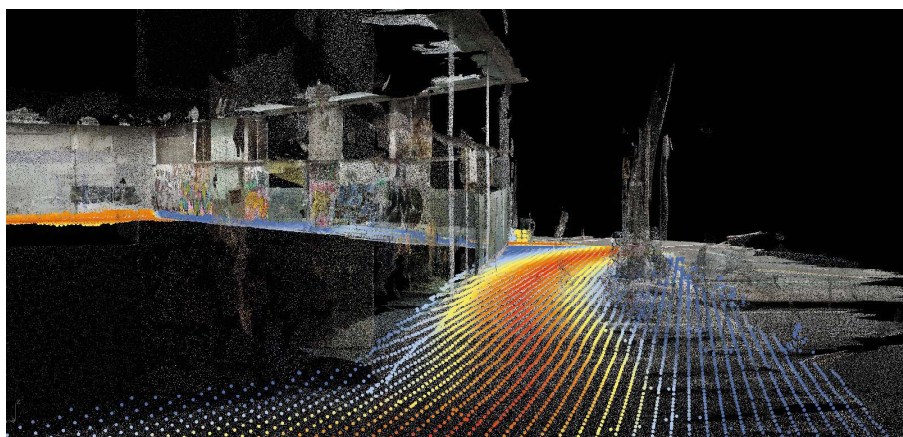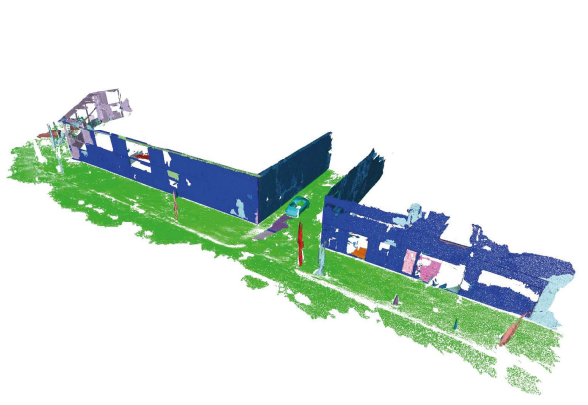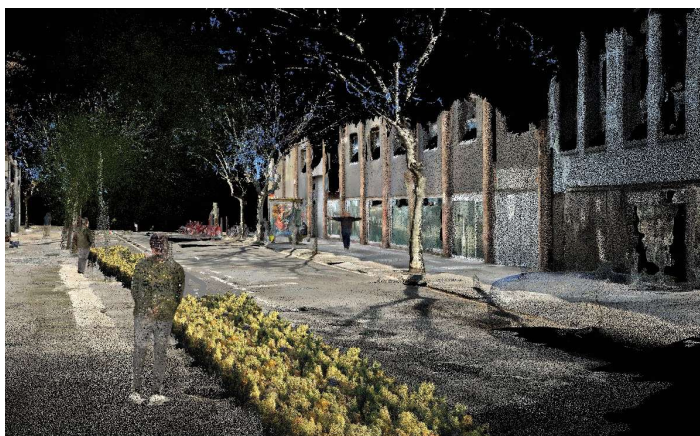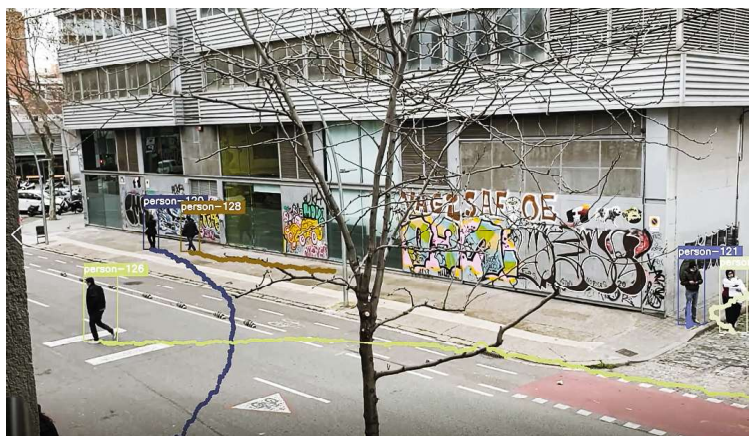## Institute for Advanced Architecture of Catalonia
Student
Barcelona, Spain | February 2022 | 2 Months
Digital Study.

The population in Barcelona has almost doubled over the past 50 years, however the city size remains quite unchanged. How can we then accommodate for the urban infrastructure required by a modern and growing society? We decided to focus on human mobility as it is one of many factors dictating city planning decisions, so we set out to study which spaces humans are occupying, and more importantly which spaces they aren't. This project aimed to tackle this problem by using computer vision to detect, track and record pedestrian movement in a city, and introduce urban utility where unoccupied spaces could be found.

• Utilized YOLOv4 Convolutional Neural Network for real-time object detection w/ DeepSORT for identification & tracking.
• Recorded pedestrian paths & used satellite data to homographize those coordinates & generate a 2D occupancy grid.
• Generated a 3D point cloud and mesh of the space using photogrammetry and LIDAR scanning.
• Point Cloud segmentation to obtain ground and walls using Metashape & Open3D in python.
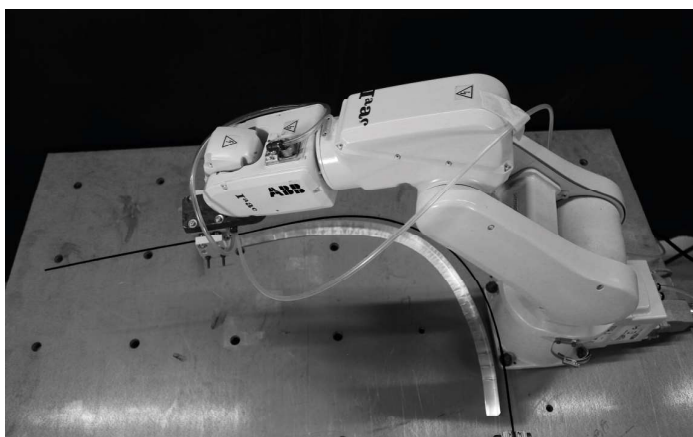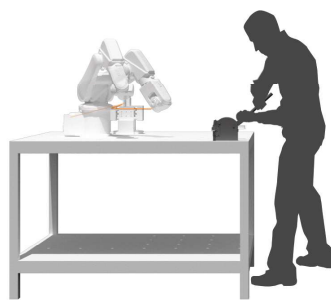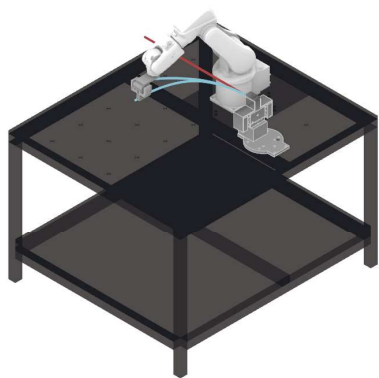• Created an algorithm in Grasshopper to populate voids with urban furniture and greenery.
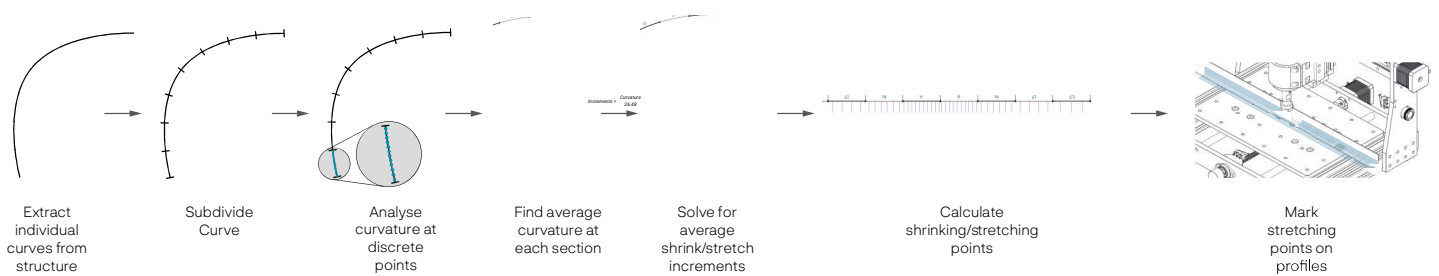
Robotic Templating for Profile Bending
Institute for Advanced Architecture of Catalonia
Student
Barcelona, Spain | December 2021 | 3 Months
Study & Prototype.

In this project we researched the automation of manufacturing metal profiles. More specifically the bending of structural profiles to precisely achieve a desired curve. In this project we explore the bending of aluminum profiles which are ideally shaped for lightweight reinforced structures in automotive and aerospace industries. We chose Aluminum L-shaped profiles because of their ease of use with a shrinker-stretcher which was available in the workshop but the application can be extended to other shapes and sections.

• Studied material and tool properties in order to develop a parametric script which would aid fabricators by using a robot to replicate the desired curves with a bendable rod as well as calculated at what points a profile needs to be stretched or shrunk.
• Used Kangaroo physics simulations of elastica curves in order to ensure the accuracy of the bended rods.
• Created a small prototype of a substructure of a doubly-curved surface from L-shaped aluminum profiles.

| Extract individual curves from structure | Subdivide Curve | Analyse curvature at discrete points | Find average curvature at each section | Solve for average shrink/stretch increments | Calculate shrinking/stretching points | Mark stretching points on profiles |

ROS - Drone Workshop
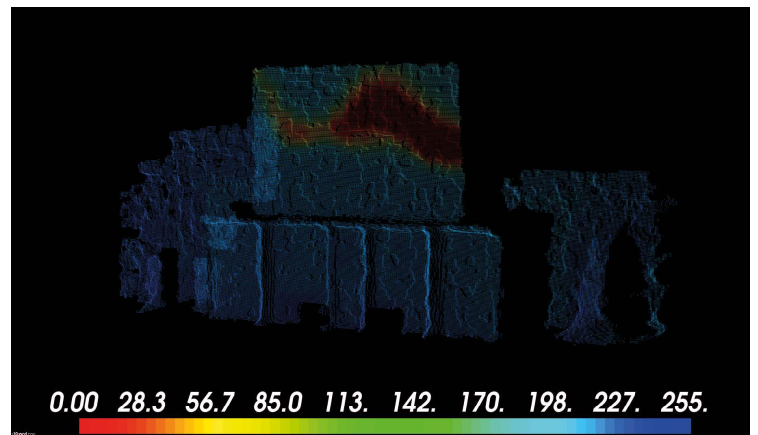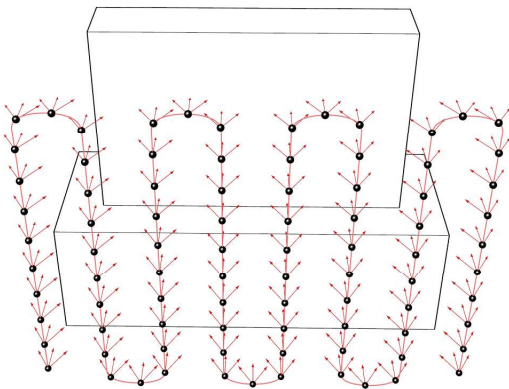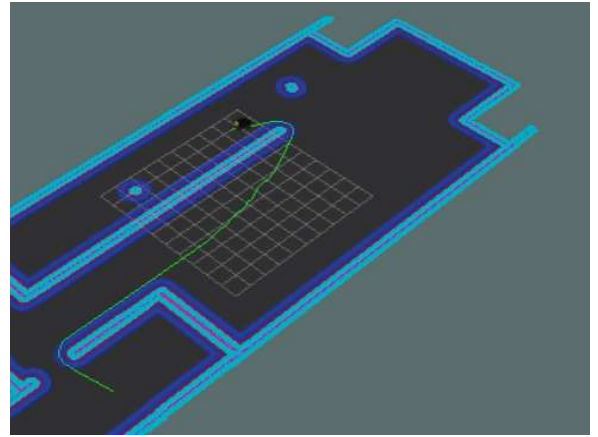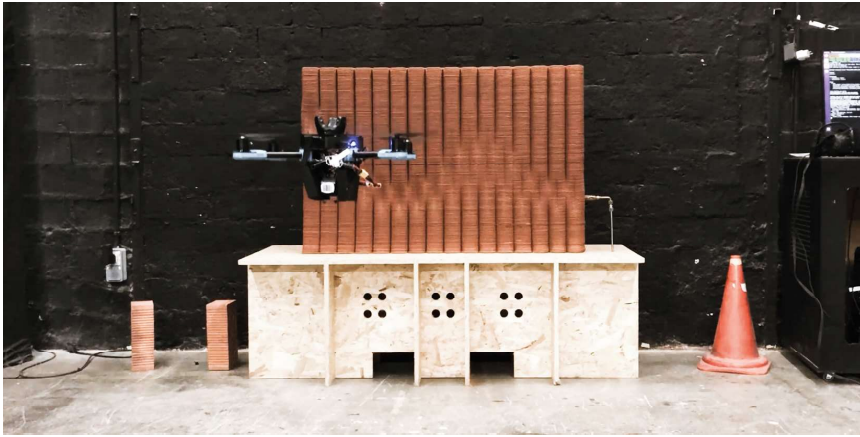## Institute for Advanced Architecture of Catalonia
Student
Barcelona, Spain | March 2022 | 1 Week
Robotic Study.

Imagine being able to understand the thermal properties of a building at the millimeter scale by simply sending a drone equipped with a thermal camera to autonomously navigate the building. The aim of this workshop was to enhance our skills in ROS and develop a proof of concept.

• Used ROS for drone navigation and path planning and created a network bridge with Grasshopper in order to be able to parametrically generate new drone paths.
• Used a point cloud assembler package in ROS which allowed us to generate a thermal 3D point cloud of a clay 3D printed wall heater.
• Learned how to use this technology to identify the thermal properties of a wall and be able to suggest remedies for thermal leaks at specific points.

0.00 28.3 56.7 85.0 113. 142. 170. 198. 227. 255.
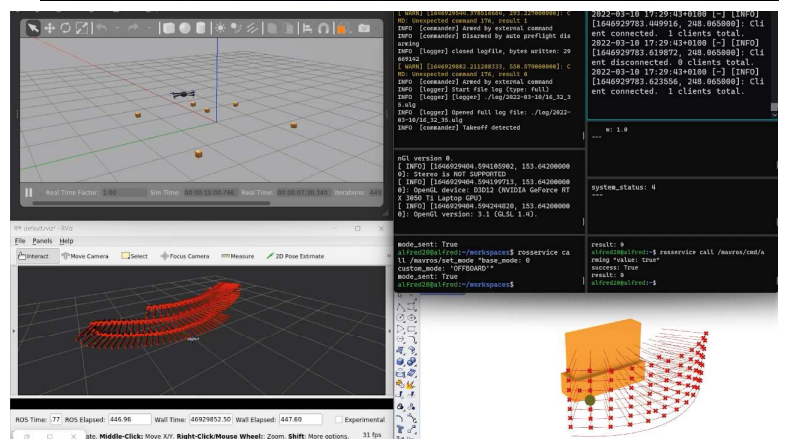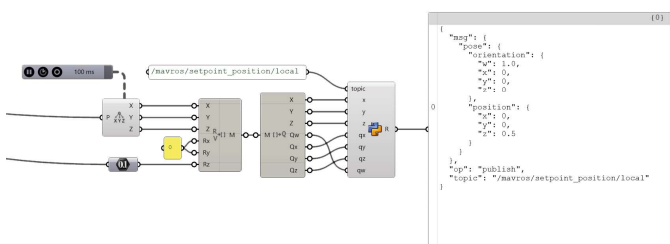
Mixed Reality Workshop - Holographic Assited Design
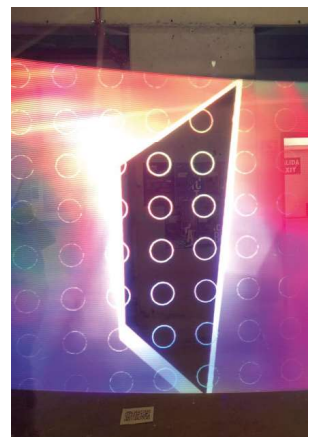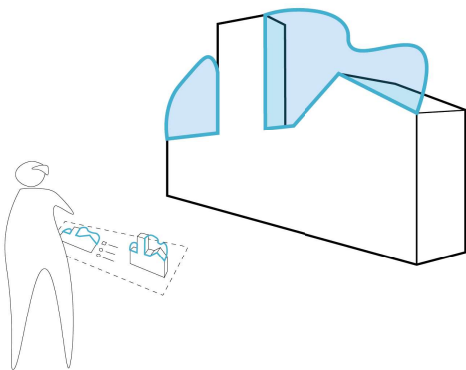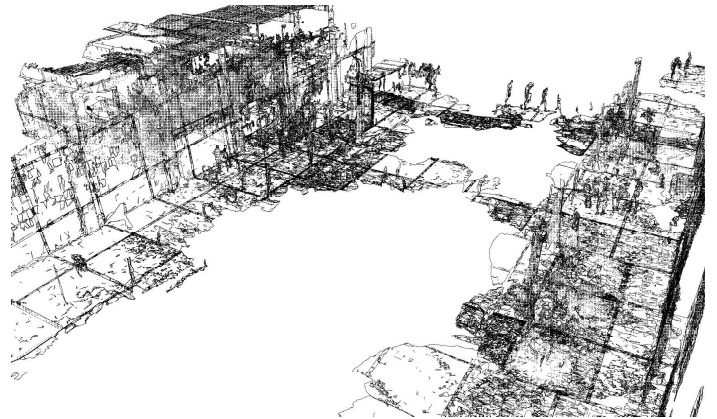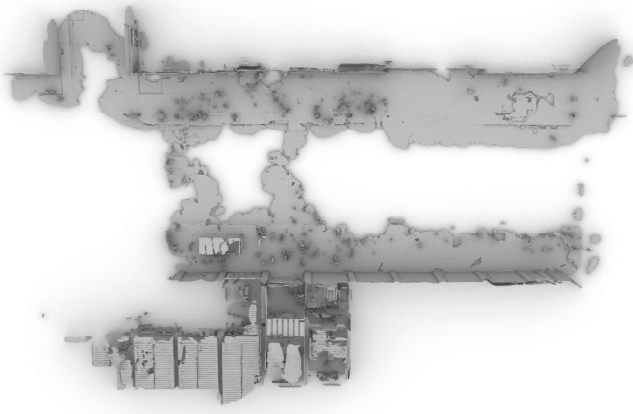## Institute for Advanced Architecture of Catalonia
Student
Barcelona, Spain | January 2022 | 1 Week
Digital & Hardware Study.

In this 1 week workshop I learned how to use AI-assisted spatial analytics, mixed reality (MR), spatial tracking, intelligent components, and other sensing technologies in order to generate new design tools. We used the Hololens Mixed Reality headset to create a prototype of a tool which would allow designers to generate designs in VR and view them in real-time at a 1-1 scale.

• Used Photogrammetry and LIDAR scanning in order to generate a comprehensive 3D textured spatial representation
• Used the Microsoft Hololens MR headset along with the Fologram plugin in GH in order to generate parametrically modifiable designs in real-time overlaid on real buildings
• Used hand tracking to create new MR functions and tools generated by different hand gestures.
• Created an MR platform which allowed a user to generate a building facade on-site in a 1-to-1 scale, and incorporated different options to generate voids and windows and different levels of facade triangular subdivisions.
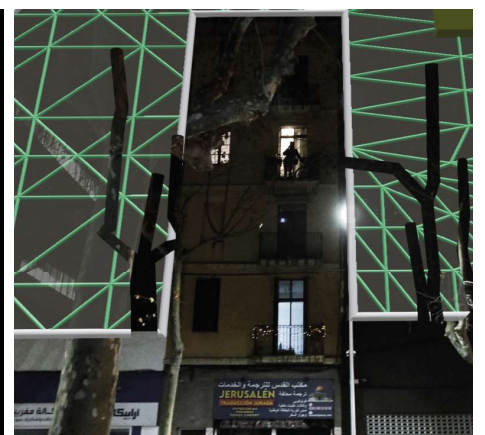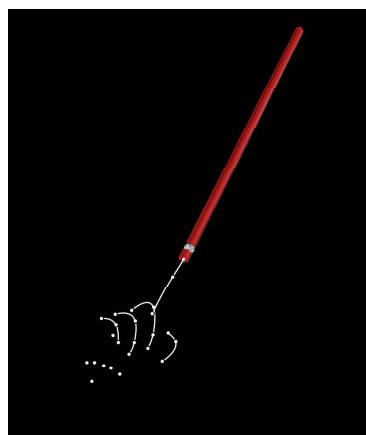
ROS - LINKBOT
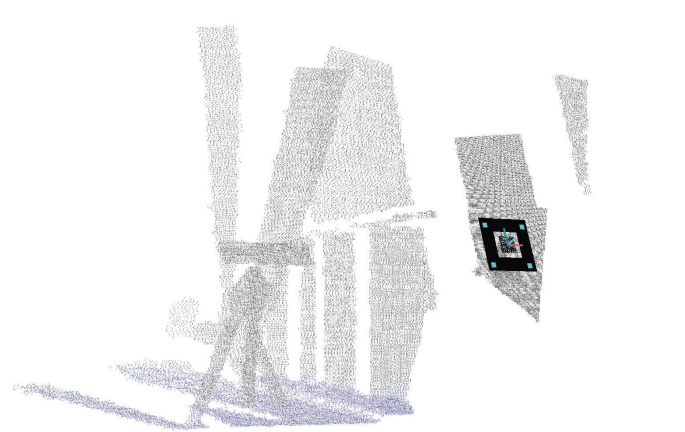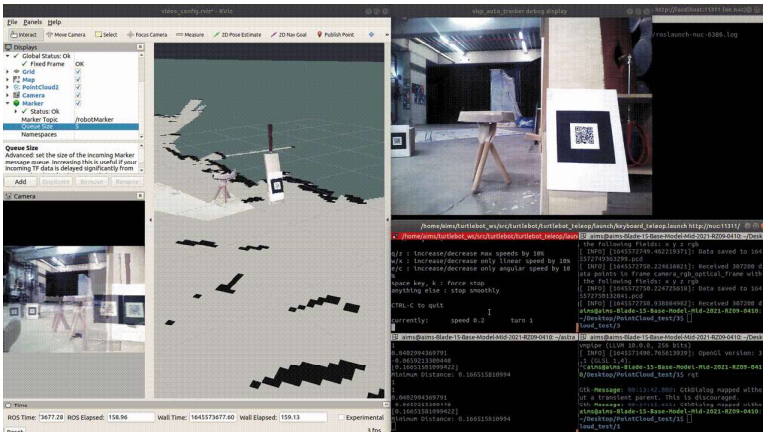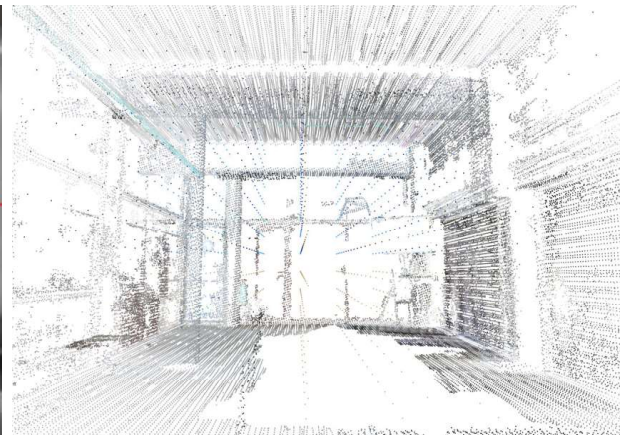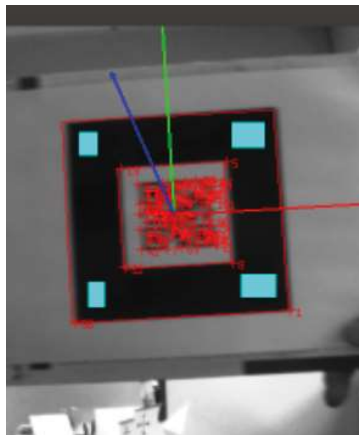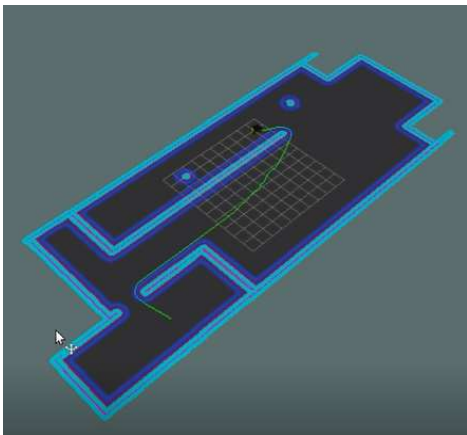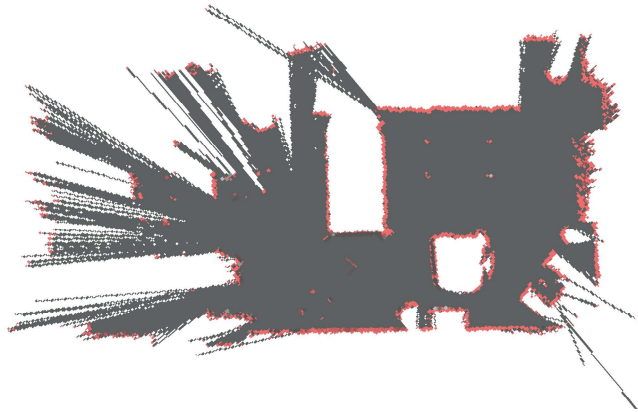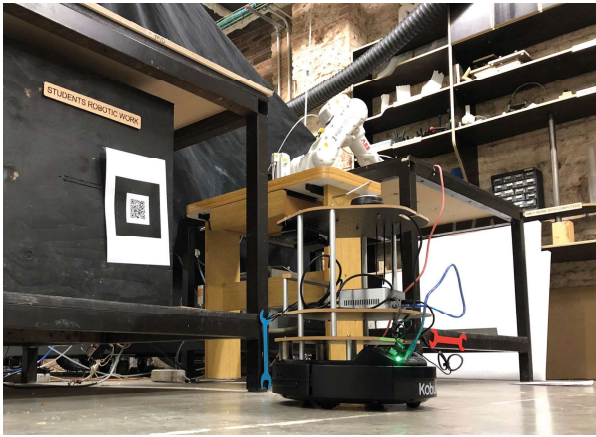## Institute for Advanced Architecture of Catalonia
Student
Barcelona, Spain | February 2022 | 2 Months
Digital & Hardware Study.

The real world and the virtual world are difficult to keep aligned on a worksite and site managers often have to perform periodic site inspections and manually update excel sheets and snag lists which can be tedious and prone to errors. The aim of this project was to have a Turtlebot rover, equipped with a depth camera and LIDAR scanner, navigate autonomously throughout a worksite and detect QR codes which would be placed by site managers. Those QR codes would contain detailed information about the issue and be updated automatically to an online database every time the turtlebot does a daily inspection of the site.

• Used the AMCL navigation algorithm for SLAM in ROS for path planning and autonomous navigation around the site
• Scanned the site using the turtlebot LIDAR scanner and obtained a 2D cost map, as well as a 3D point cloud of the site
• Used the visp ROS package in order to autonomously detect QR codes in a space and place a marker on the map.

Mesh Topology Study
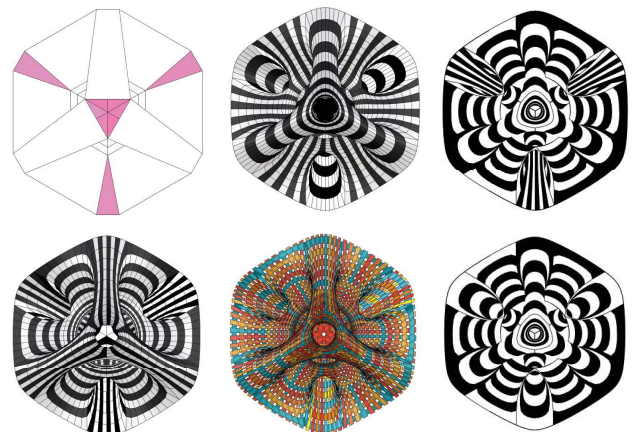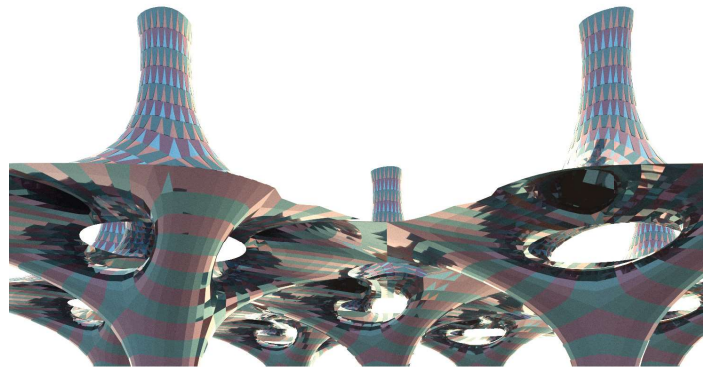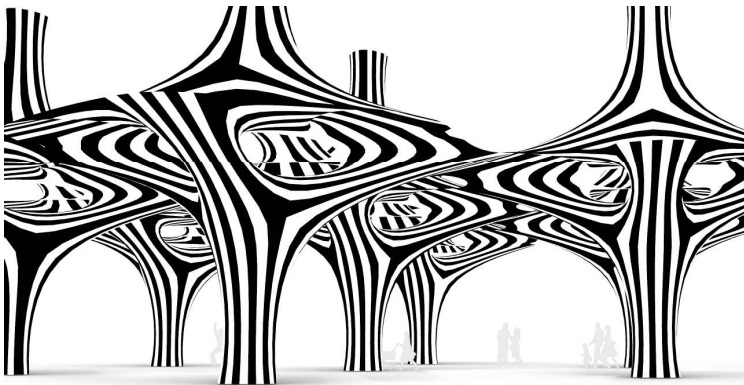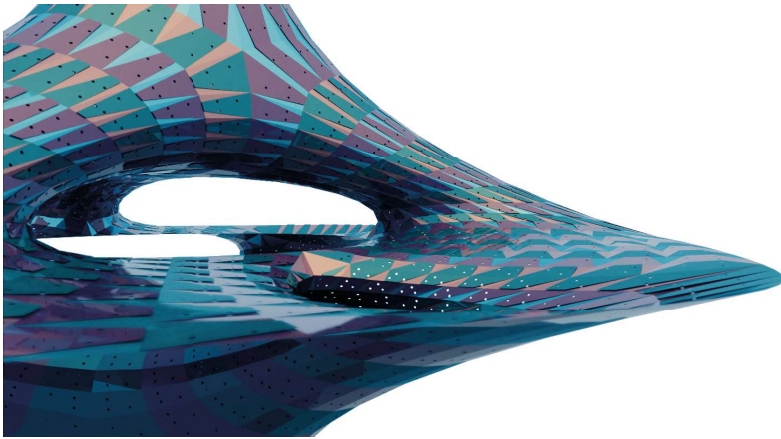## Institute for Advanced Architecture of Catalonia
Student
Barcelona, Spain | December 2021 | 2 Months
Digital.

The aim of this project was to understand mesh geometry syntax and features, topology structures and learn algorithmic strategies to approach computational design and digital fabrication. Through the manipulation of advanced data trees, we were able to develop complex geometrical shapes while retaining control on every aspect of the design.

• Generated complex forms by starting with simple input meshes utilizing Kangaroo for mesh relaxation.
• Manipulated mesh topology in order to obtain different striping patterns to optimize manufacturing and aesthetics.
• Developed discretized 2D strips which could be laser cut and assembled to create our final geometry.

Robotic Fabrication Workshop
Institute for Advanced Architecture of Catalonia
Student
Barcelona, Spain | January 2022 | 1 Week
Robotic Study.

In this one week workshop we developed a grasshopper script to print spatial non-standard large-scale lightweight structures that outperform the usage of material per load capabilities through robotic additive manufacturing. The objective of the workshop is to prototype, fabricate and test simple structural models through robotic non-planar additive manufacturing.

• Established communication between the ABB arm robot and custom end effector.
• Created structural nonplanar additive manufacturing strategies while accounting for layer adhesion and avoiding collisions.
• Printed a 60cm long spatial lattice bridge structure and tested it under a 5 kg load.
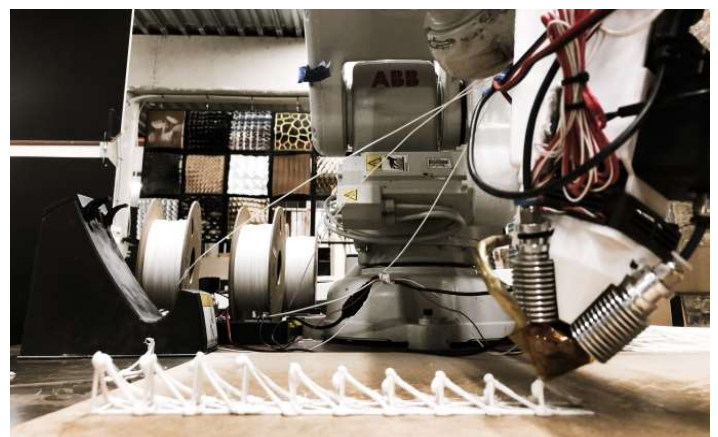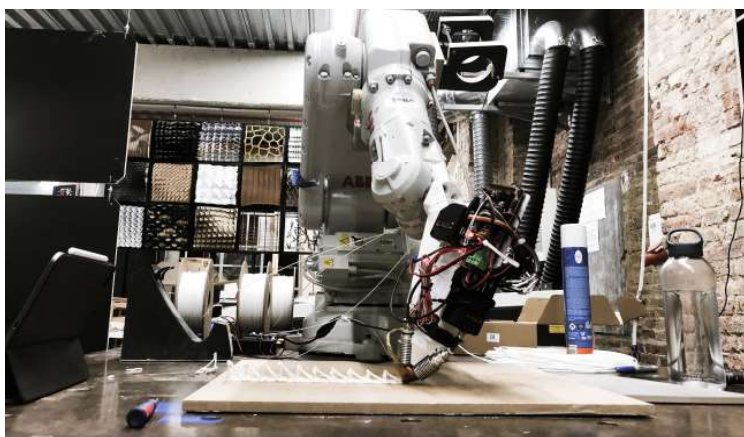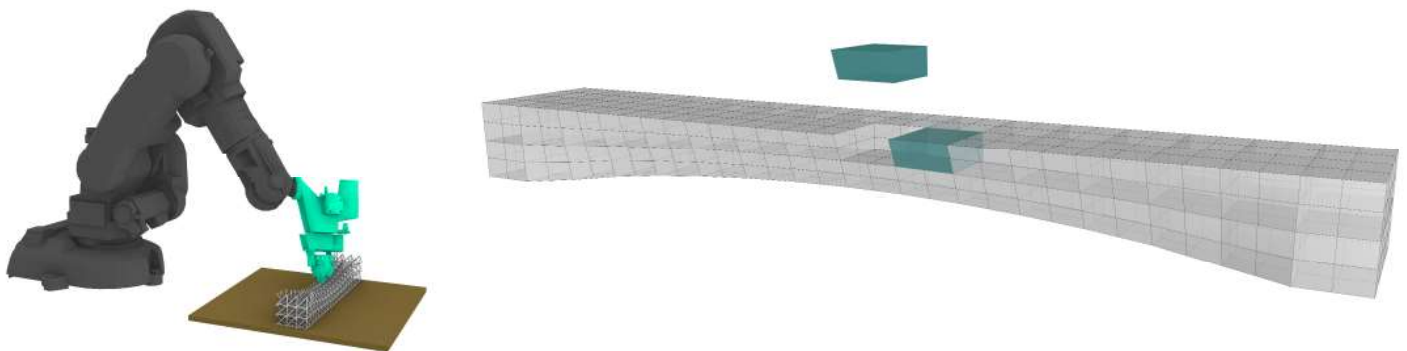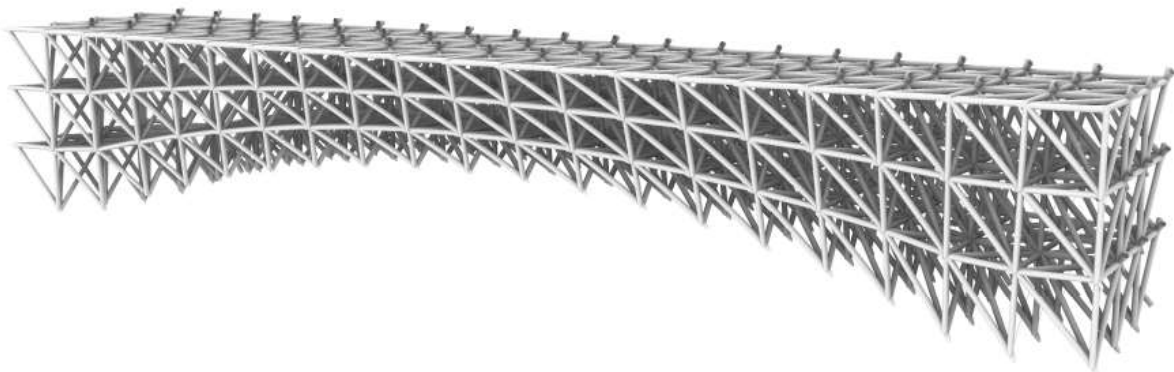
Rigid Origami Pergola
Innovation Factory Beirut
Design Engineering Intern
Beirut, Lebanon | December 2017 | 3 Months
Prototype.

The pergola was conceived as an idea for a sun-shade which would follow the sun's path by moving on an arced rail on a highrise in Beirut's city center. Using sensors as well as manual control from the users, the pergola would open and close autonomously using the principles of rigid-origami and a series of hidden motors.

• Designed a prototype of a pergola for a client using the principles of rigid origami with the objective of building the final product.
• 3D printed custom hinges, as well as a custom rack and motor which controlled the opening of the pergola from its base.
• Used an arduino to manually control the stepper motors which allowed the pergola to smoothly open and close.