S-rover

Brief Description

A small solar device with two equivalent axes of active tracking. The rover automatically adjusts the photovoltaic surface to try to maximize the amount of light being harvested. The device adapts to considerable changes in the lighting environment and the displacement of the platform itself. It can be used for charging batteries that can power other electronics once S-rover returns fully charged. Also, it can be adapted to perform simple robotic tasks that require displacement for extended periods of time.

Manufacturing Plan

The whole device is composed of only standard components, laser-cut parts, and 3D printed parts. It was designed to simplify the manufacturing process to facilitate a DIY approach. Most of the parts are flat and designed to be laser-cut in 1/8" acrylic or plywood. If acrylic is chosen as the main material, it is recommended to weld the parts instead of using regular glue, for instance, use SCIGRIP Weld-On #3

(https://www.amazon.com/gp/product/B079J4KGMC/ref=ppx_yo_dt_b_asin_title_o03_s00?ie=UTF8&psc=1).   On   the other hand, if plywood is chosen, it is recommended to use transparent glue for wood.

- Total Number of Standard Components: **205**
- Number of 3D-printed parts: **10**
- Number of laser-cut parts: **242**
- Total Number of parts: **457**
- Number of unique part types (not including repetitions): **101**
- **Estimated cost of components and materials: 680 USD**
- **Estimated Number of hours required (without programming and fine-tuning): 40-50 h**
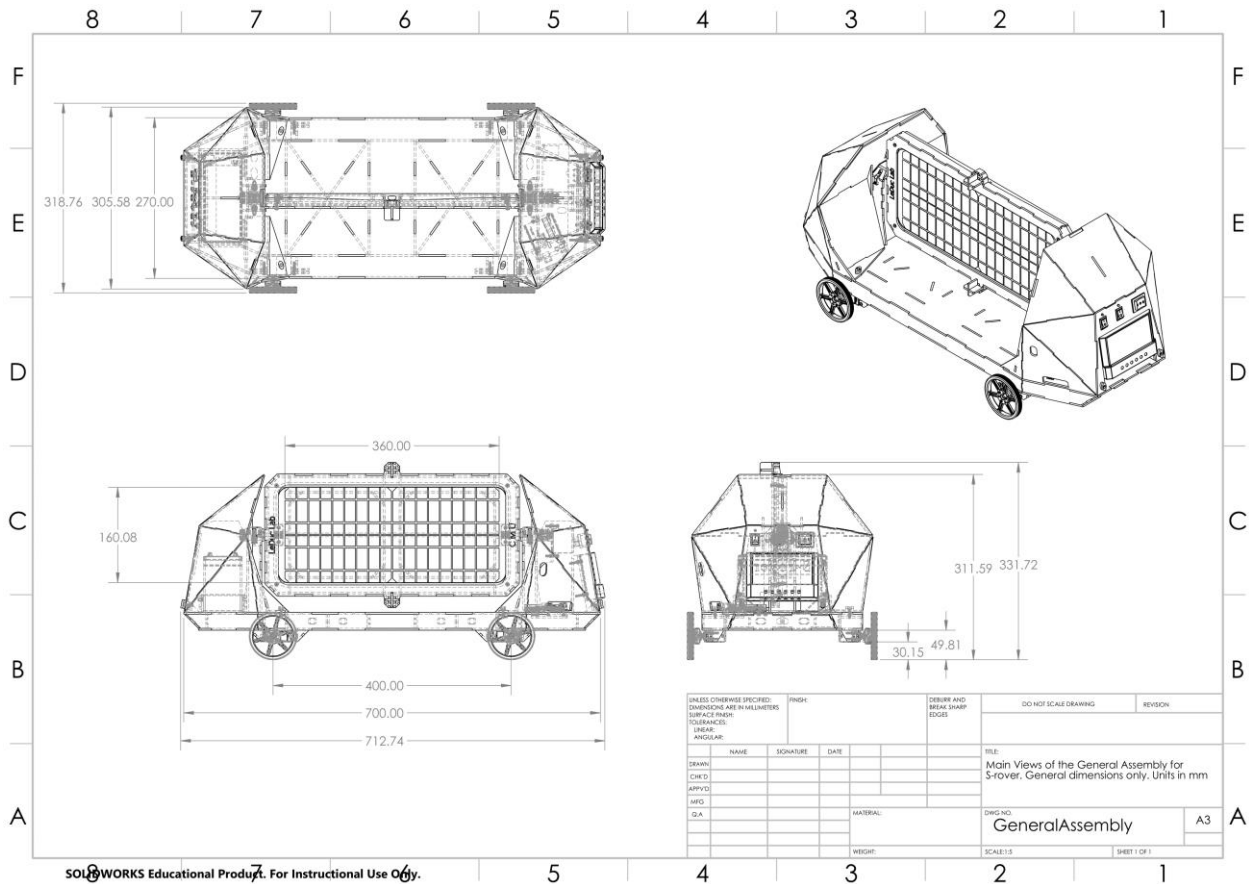
3D-Printed Parts:
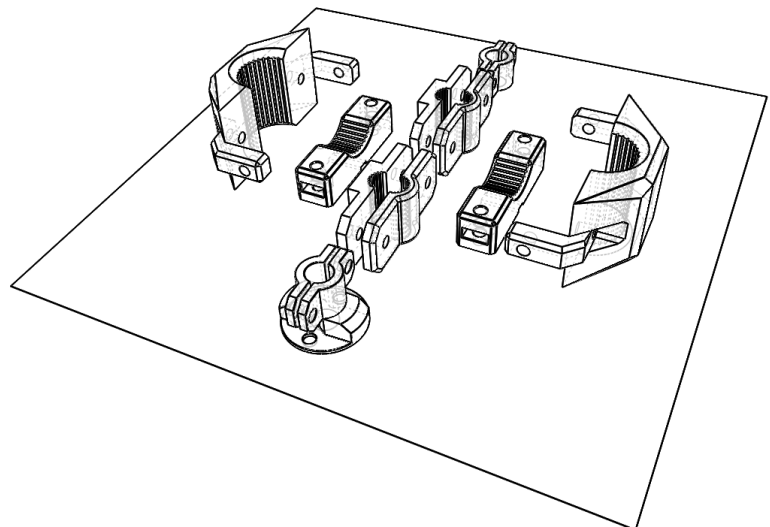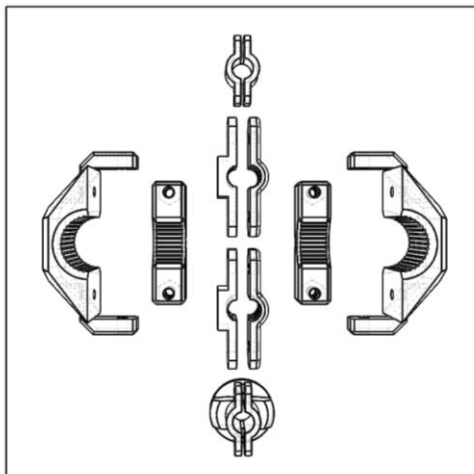
Standard Components

The following are the standard components. Providers are presented at the end of the document.

Standard components

- MOOLSUN Solar Panel 10W
- Bearing 1/4"x5/8"x0.196" (2)
- Washer 0.266"x0.812" x0.08" (4)
- Servo Horn (5)
- Pololu 8cm wheels (4)
- Photoresistor 5mm (8)
- Switch 2-Position (2)
- Solar Charger Controller
- Arduino UNO
- Board
- DC-DC converter 5V
- Switch 3-Position
- Lead Acid Battery 12V 7 Amp
- Continuous Rotation Servo (4)
- FS5106B 180° servo
- Hex Bolt M3x25mm (12)
- Screw M3x20mm (32)
- Screw M3x12mm (41)
- Hex Nut M3 (80)
- Steel Axel 1/4"

General Assembly Views and Dimensions

318.76 305.58 270.00

360.00

160.08

400.00

700.00

712.74

311.59 331.72

30.15 49.81

UNLESS OTHERWISE SPECIFIED:	FINISH:		DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION

DIMENSIONS ARE IN MILLIMETERS
SURFACE FINISH:
TOLERANCES:
LINEAR:
ANGULAR:

	NAME	SIGNATURE	DATE		TITLE:
DRAWN					Main Views of the General Assembly for S-rover. General dimensions only. Units in mm
CHK'D					
APPV'D					
MFG					
Q.A			MATERIAL:		DWG NO. GeneralAssembly

A3

WEIGHT: SCALE:1:5 SHEET 1 OF 1

Drawings of the main Exploded Views

ITEM	COMPONENT	QTY.
1	Panel Sub-assembly	1
2	Body Sub-assembly	2
3	Chassis Sub-assembly	1
4	FS5106B 180 deg Servo	1
5	Continuous rotation Servo	4
6	Wheel Sub-assembly	4
7	Lead Acid 14V 7Amp Battery	1
8	Solar Charger Controller	1
9	Arduino UNO	1
10	DC-DC converter 5V	1
11	3-Position Switch	1
12	2-Position Switch	2

TITLE: Exploded View of the sub-assemblies and main components in the General assembly.

DWG NO. GeneralAssembly   A3

SCALE:1:3   SHEET 5 OF 5

ITEM	COMPONENT	QTY.
1	Solar Panel MOOLSUN 10W	1
2	Top Subassembly	1
3	Base Subassembly	1
4	Photoresistors 5mm	8
5	Steel Axel 1/4"	1
6	Screw M3 x 20mm	4
7	Screw M3 x 12mm	6
8	Hex Nut M3	14
9	Hex Bolt M3 x 25mm	4
10	Bearing 1/4"x5/8"x0.196"	2
11	Washer 0.266"x0.812"x0.08"	4
12	Servo Horn	1
13	3D Printed axel grips	2

Assembled

TITLE: Exploded View of the sub-assemblies and components in the Panel assembly.

DWG NO. Panel Assembly   A3

SCALE:1:3   SHEET 4 OF 4

Part Drawing of an Example of a Laser-Cut part

Technical Drawing of the part SubSP_Top. This is an example of a laser-cut part in 1/8" acrylic that is part of the Panel Sub-assembly. Units shown are in mm.

Laser-cut Part example | A3 | SCALE:1:3 | SHEET 3 OF 3

Part Drawing of an Example of a 3D-Printed part

Technical Drawing of the part SubSP_AxelC. This is an example of a 3D printed part that is part of the Panel Sub-assembly. Units in mm.

3D Printed part example | A3 | SCALE:3:1 | SHEET 2 OF 2

Assembly Guidelines

1. Assemble each frame and body sub-assemble by welding/glueing the laser-cut parts and using the mechanical fastening elements. For example, this is the top sub-assembly of the Panel assembly:
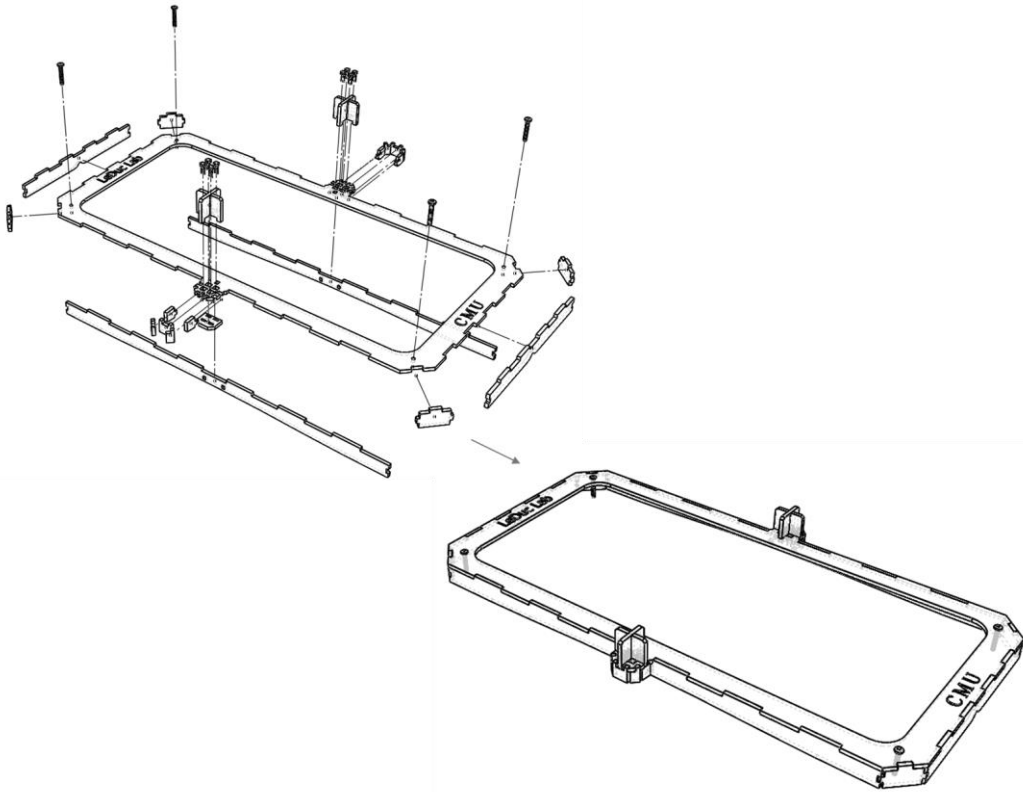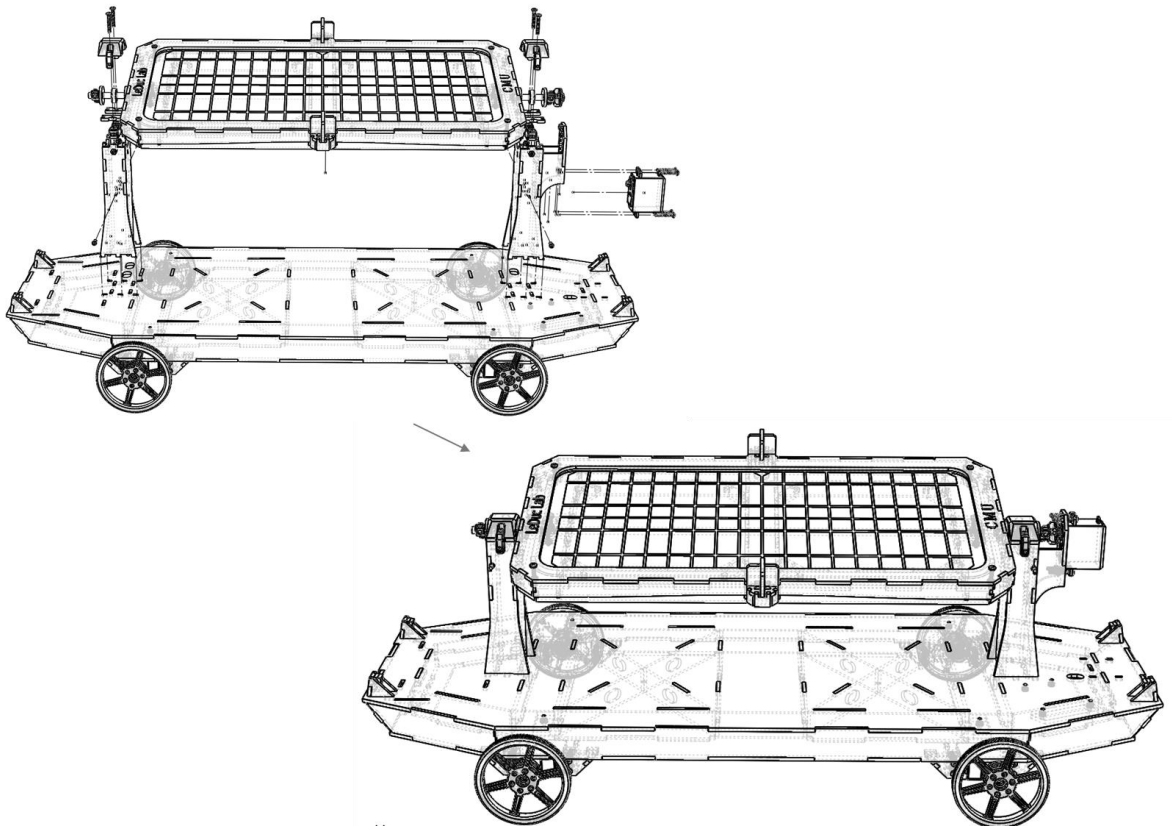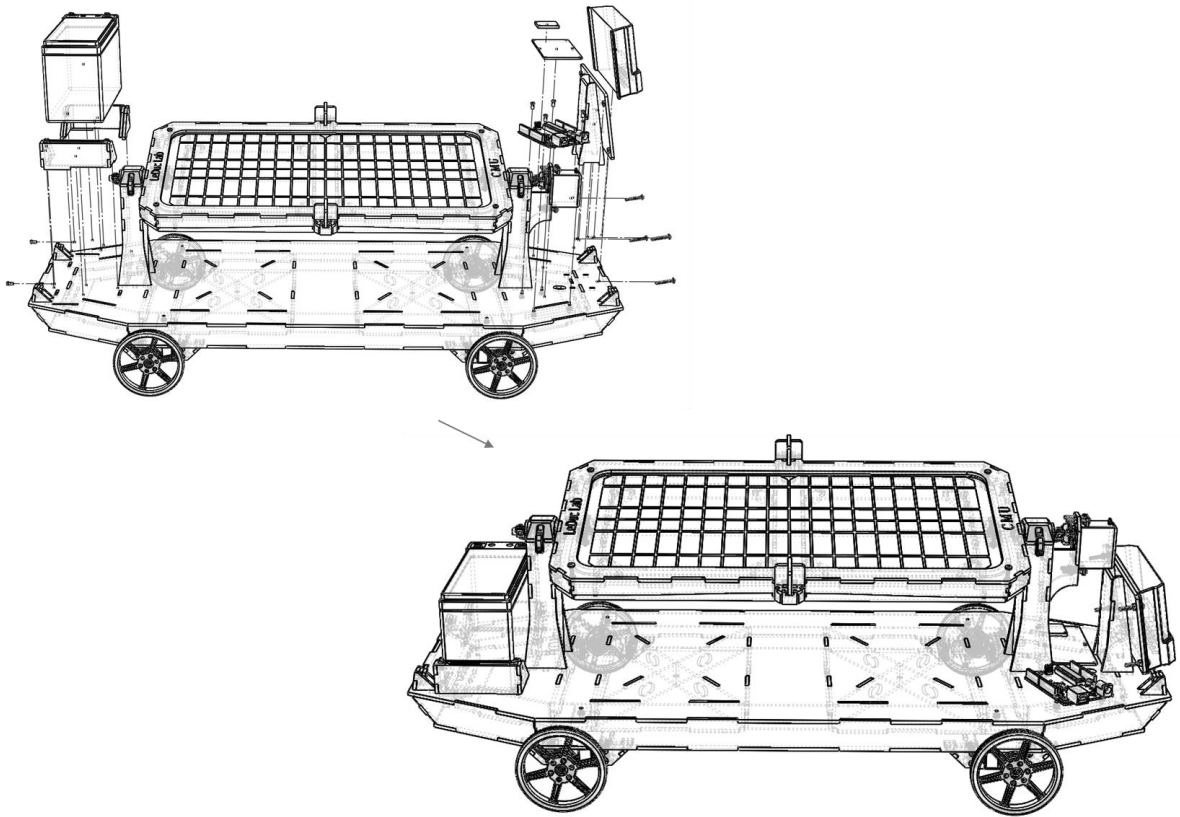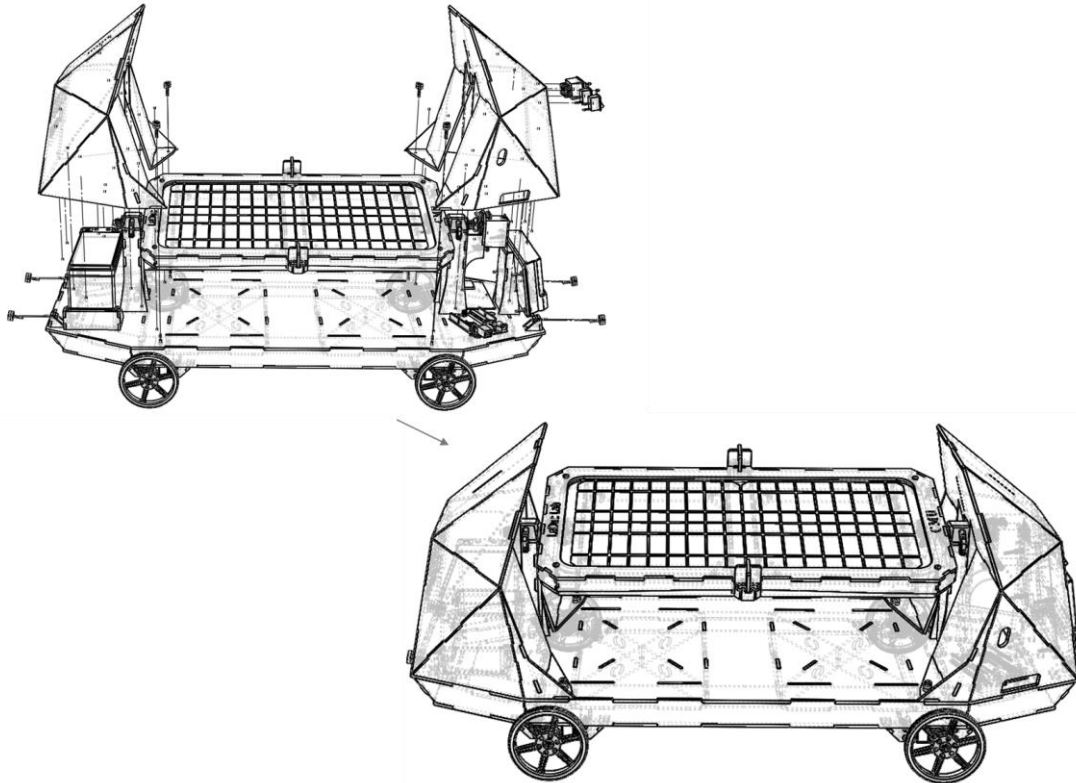
2. Assemble the Panel Assembly:

3. Assemble the Wheel Assemblies (x 4):

5. Assemble the Chassis frame, then the Servos, and then the Wheel Assemblies:
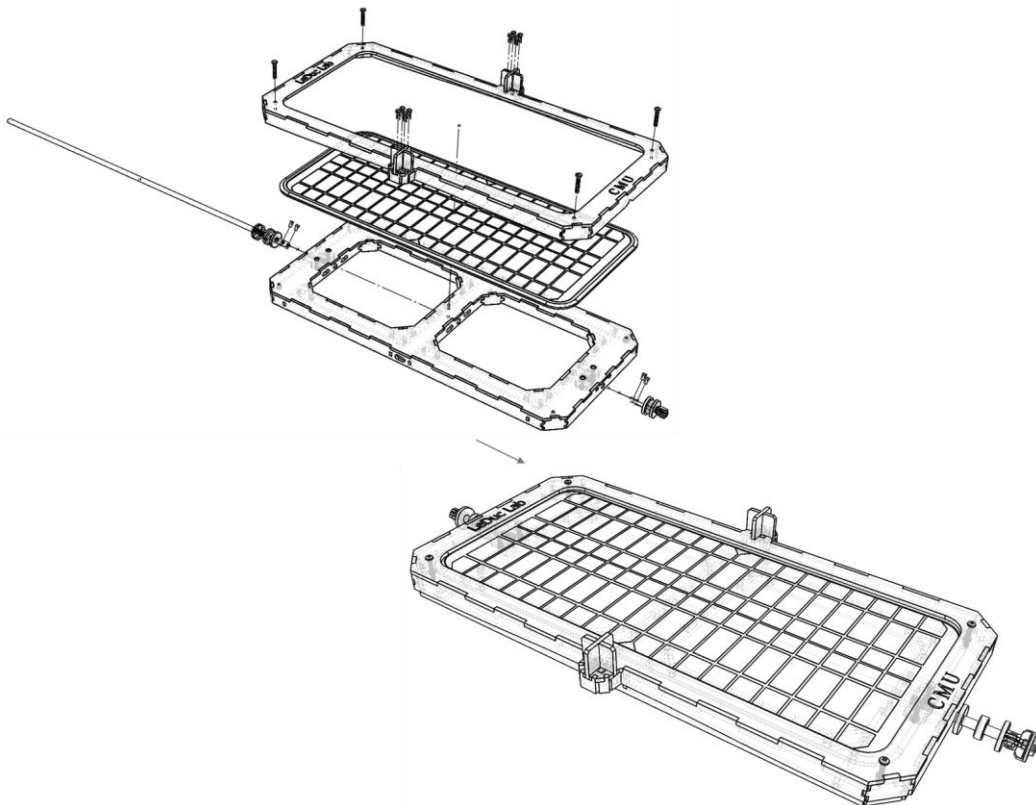
6. Assemble the tower structures that hold the Panel to the Chassis frame and then secure the panel mechanism:

7. Assemble the main electronic components to the Chassis frame:

8. Assemble the external body surfaces:

Providers

- **Solar Panel**
  Price: **$30**
  https://www.amazon.com/dp/B082DCMFZS/ref=psdc_2236628011_t1_B081YRGJHV
  MOOLSUN 12 Volt 12v Solar Battery Charger, 10W Solar Car Battery Charger, Solar Trickle Charger, Solar Panel Battery Maintainer, Power Kit Portable Backup for Automotive, Motorcycle, Boat, Marine, RV by MOOLSUN

- **Solar Charger Controller**
  Price: **$15**
  https://www.amazon.com/Controller-Battery-Intelligent-Regulator-Adjustable/dp/B072MMDY4F/ref=sr_1_3?dchild=1&keywords=solar+Charge+Controller&qid=1586056418&sr=8-3
  20A Solar Charge Controller Solar Panel Battery Intelligent Regulator with Dual USB Port 12V/24V PWM Auto Paremeter Adjustable LCD Display

- **Battery**
  Price: **$17.5**
  https://www.amazon.com/ExpertPower-EXP1270-Rechargeable-Lead-Battery/dp/B003S1RQ2S/ref=sr_1_2?dchild=1&keywords=battery+lead-acid&qid=1586369496&sr=8-2
  ExpertPower 12V 7 Amp EXP1270 Rechargeable Lead Acid Battery

- **DC-DC Converter**
  Price: **$20**
  https://www.pololu.com/product/4091
  Input voltage of up to 50 V and efficiently reduces it to 5 V. The board measures only 1" × 1" yet delivers typical maximum continuous output currents between 3.5 A and 8 A, depending on the input voltage, which makes it well suited for powering moderate to large loads.

- **Arduino UNO**
  Price: **$20.5**
  https://www.amazon.com/Arduino-A000066-ARDUINO-UNO-R3/dp/B008GRTSV6/ref=sr_1_3?dchild=1&keywords=arduino+UNO&qid=1586062798&sr=8-3
  The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.

- **180 deg Servo**
  Price: **$11.95**
  https://www.pololu.com/product/3425/specs
  This servo can work with both 5 V and 3.3 V servo signals. The FS5106B works with standard RC servo pulses, providing a running angle of approximately 180° over a servo pulse range of 700 µs to 2300 µs

- **360 deg Servo**
  Price (4 units): **$67.8**
  https://www.amazon.com/American-Robotic-Supply-Continuous-Rotation/dp/B01MSAIL3D/ref=sr_1_3?dchild=1&keywords=Continuous+Rotation+Servo&qid=1586311257&sr=8-3
  Continuous Rotation Servo-American Robotic Supply[4.8V—9.4kgcm]. 360° Clockwise/Counterwise Continuous Rotation. High Torque - 11 kg/cm @ 6V, 9.4 kg/cm @ 4.8V. Fast Operation - .19 sec/60° (4.8V)

- **Servo Horns**
  Price (10 units): **$8.99**
  https://www.amazon.com/Seamuing-Aluminum-Futaba-Mechanical-Helicopter/dp/B07D56FVK5
  10Pcs Servo Horn Metal Aluminum. Suitable for standard servos, like Hitec, Parallax, Futaba, and etc. the size is (40*20*36mm) /(1.57*0.8*1.42in).

- **Wheels**
  Price (4 units): **$31.8**
  https://www.pololu.com/product/3690
  Pololu 8cm wheels.

- **Bearings**
  Price (10 units): **$11.99**
  https://www.amazon.com/R4-2RS-x0-196-Premium-Sealed-Bearing/dp/B077SPSVD1/ref=sr_1_2?dchild=1&keywords=1%2F4+in+bearings&qid=1586397112&sr=8-2
  QBBC R4-2RS (1/4"x5/8"x0.196") C3 EMQ Premium Sealed Radial Ball Bearing 10 Pack.

- **Axel**
  Price: **$3.72**
  https://www.homedepot.com/p/1-4-in-x-36-in-Plain-Steel-Round-Rod-802427/204273973
  1/4 in. x 36 in. Plain Steel Round Rod.

- **2-Position Switches**
  Price (12 units): **$5.99**
  https://www.amazon.com/Rocker-Switch-Household-Appliances-MXRS/dp/B07KPYS8JT/ref=sr_1_9?dchild=1&keywords=toggle%2Bswitch&qid=1586398905&sr=8-9&th=1
  12 Pcs SPST Snap-in ON-Off 2 Pin Snap Rocker Boat Switch Black AC 250V 6A 125V 10A for Car Auto Boat Household Appliances by MXRS.

- **3-Position Switches**
  Price (12 units): **$9.69**

  https://www.amazon.com/Rocker-Switch-Household-Appliances-MXRS/dp/B07MV5TVCM/ref=sr_1_9?dchild=1&keywords=toggle%2Bswitch&qid=1586398905&sr=8-9&th=1
  MXRS Rocker Boat Switch, 12 Pcs DPDT 6 Pins Switch Snap, AC 20A/250V 15A/125V, 3 Position ON/Off/ON.

- **Photoresistors**
  Price (30 units): **$3.99**

  https://www.amazon.com/MCIGICM-Photoresistor-Sensitive-Resistor-Dependent/dp/B07PF3CWW9/ref=sr_1_2?dchild=1&keywords=photoresistor&qid=1586400754&sr=8-2
  MCIGICM 30 Pcs Photoresistor Photo Light Sensitive Resistor, Light Dependent Resistor 5 mm GM5539 5539.

- **Board**
  Price (4 units): **$11.99**

  https://www.amazon.com/Prototype-Snappable-Arduino-Electronics-Gold-Plated/dp/B08151V9TS/ref=sr_1_4?dchild=1&keywords=pcb+stripboard&qid=1586402315&sr=8-4
  PCB Prototype Board, Snappable Strip Board with Power Rails for Arduino and DIY Electronics, Gold-Plated, 3.8"x3.5" (3 Pack, Matte Black).

- **Hex Bolt M3 X 30mm**
  Price (50 units): **$6.59**

  https://www.mcmaster.com/91287A024

- **Hex nut M3**
  Price (100 units): **$0.88**

  https://www.mcmaster.com/90592A085

- **Washer**
  Price (50 units): **$10.92**

  https://www.mcmaster.com/91922A221

- **Screws 3M X 20mm**
  Price (100 units): **$3.44**
  https://www.mcmaster.com/92005A128

- **1/8" Acrylic sheets**
  Price (+/- 10 units): **$75**
  https://engineering.cmu.edu/techspark/facilities/material-list.html
  Acrylic, plastic, (12x24in sheet, 1/8in thick), $7.5/sheet

- **PLA for 3D-Printing**
  Price (+/-500g): **$250**
  https://engineering.cmu.edu/techspark/facilities/index.html

TOTAL ESTIMATED COST: $617.74 + 10% margin = $680