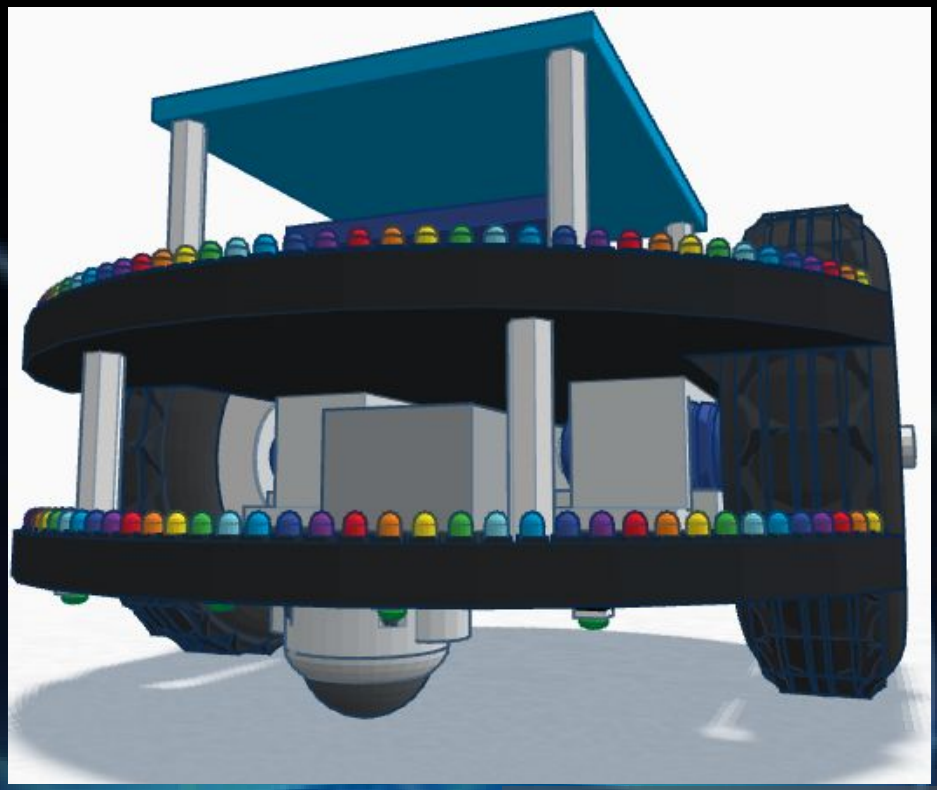
HKIE Joint Institutes Competition 2016 Ambition

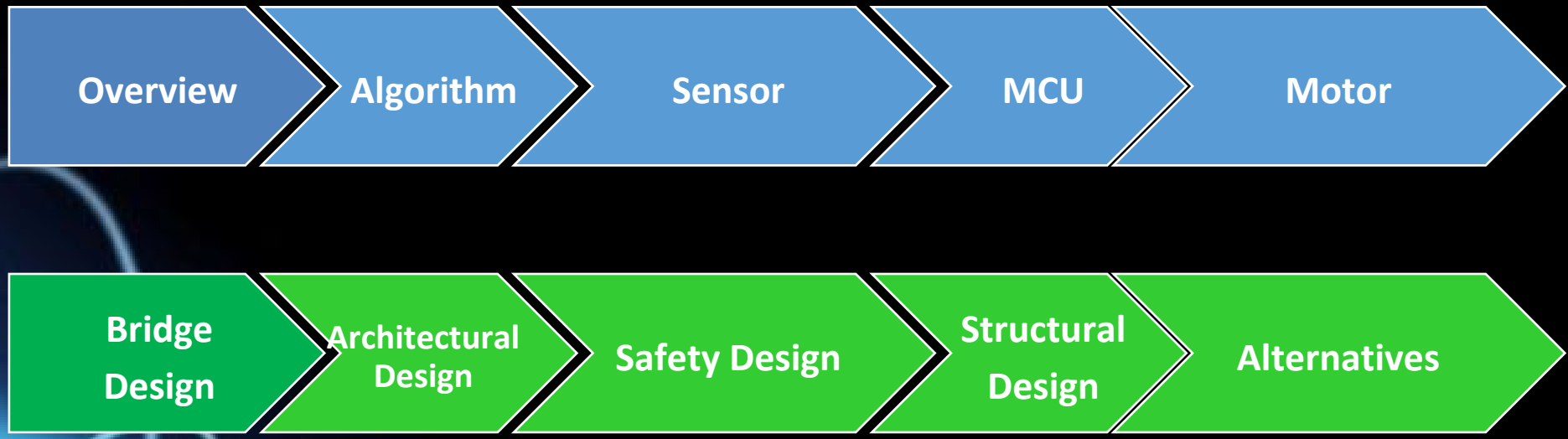
Proposal for Car Design and Bridge Design



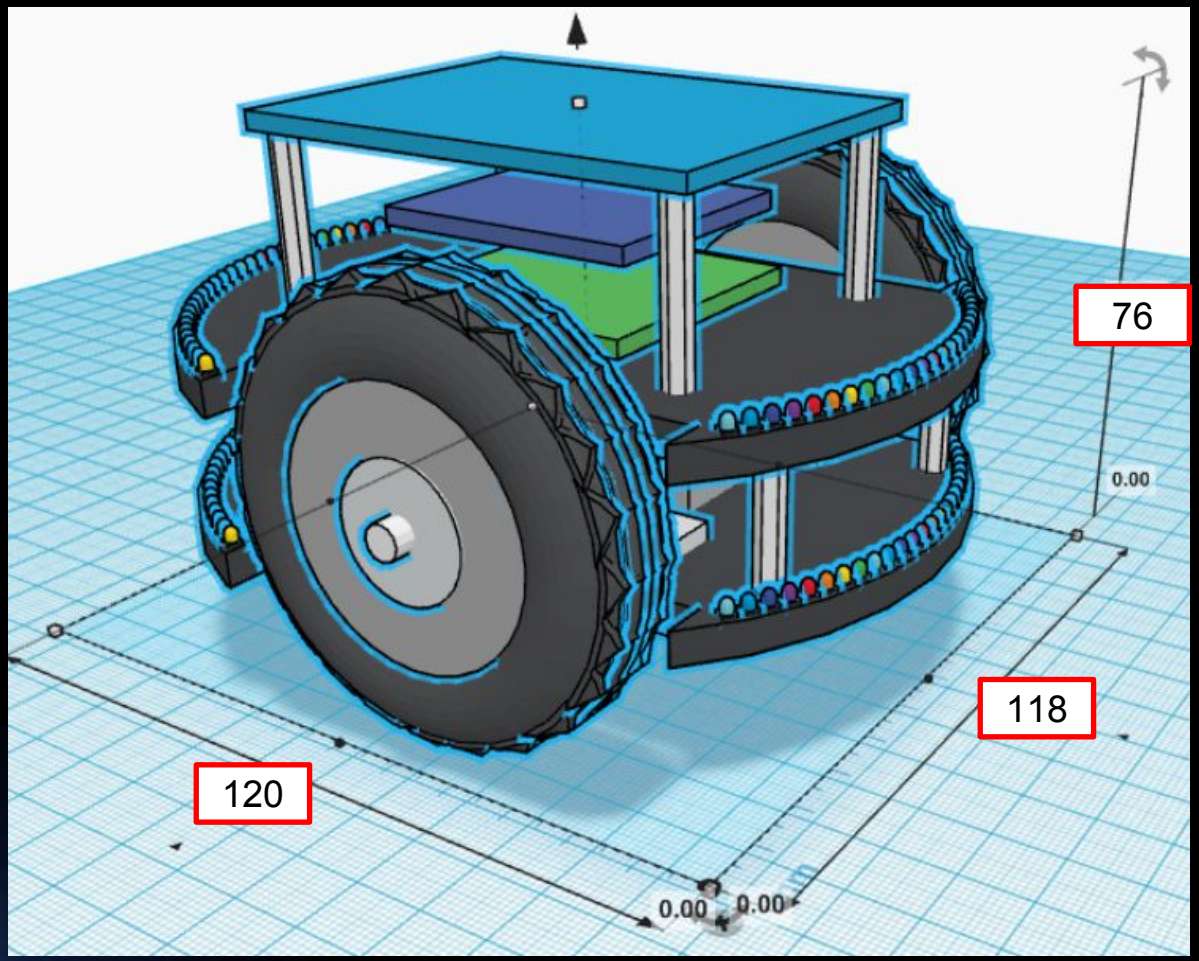
嘉頓家庭什餅攻防戰
The Garden War

Siu King Hang
Chan Chun Kei
Choi Siu Kwan
Wong Siu Hang
Yuen Chi Fai

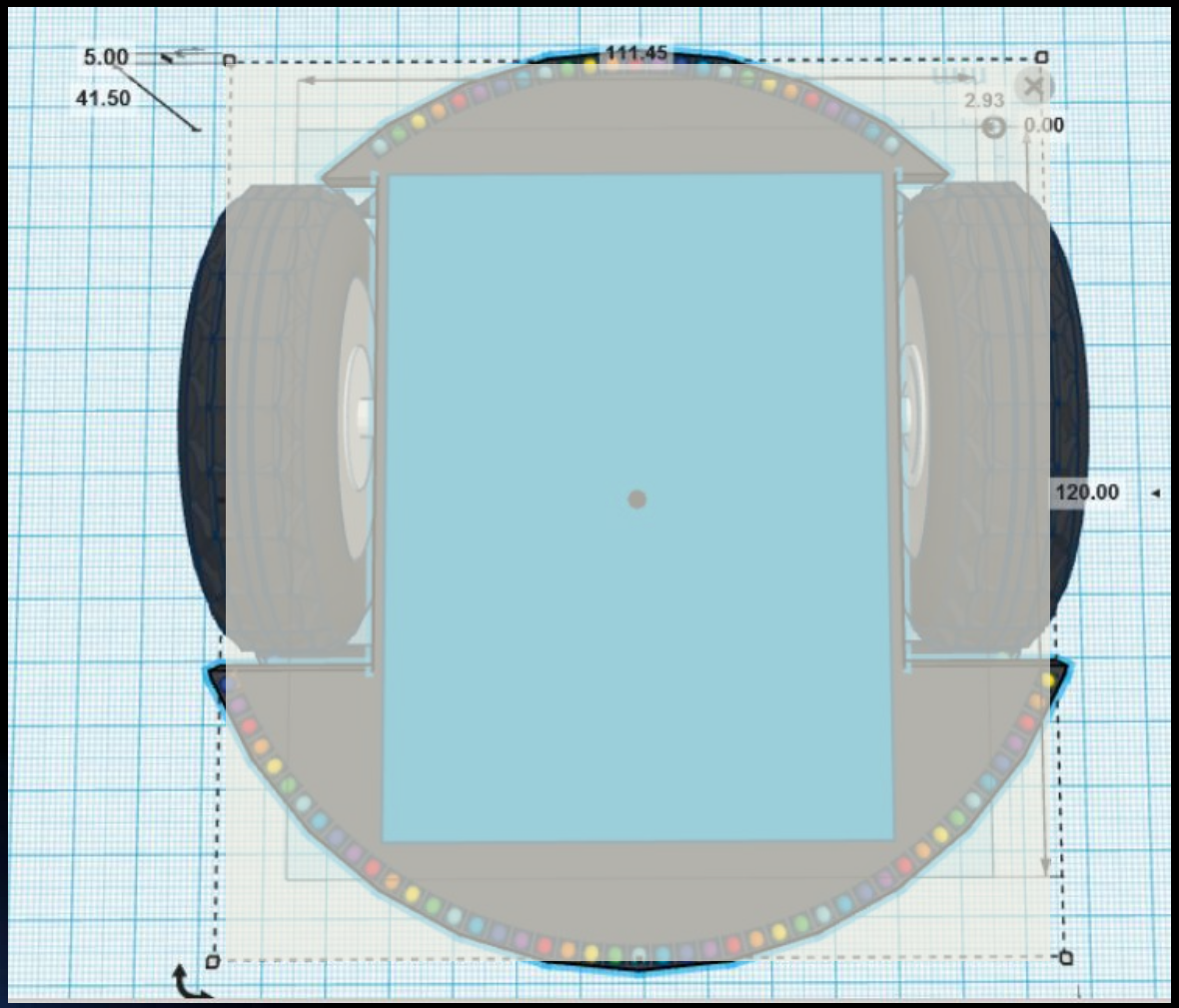
Presentation Outline



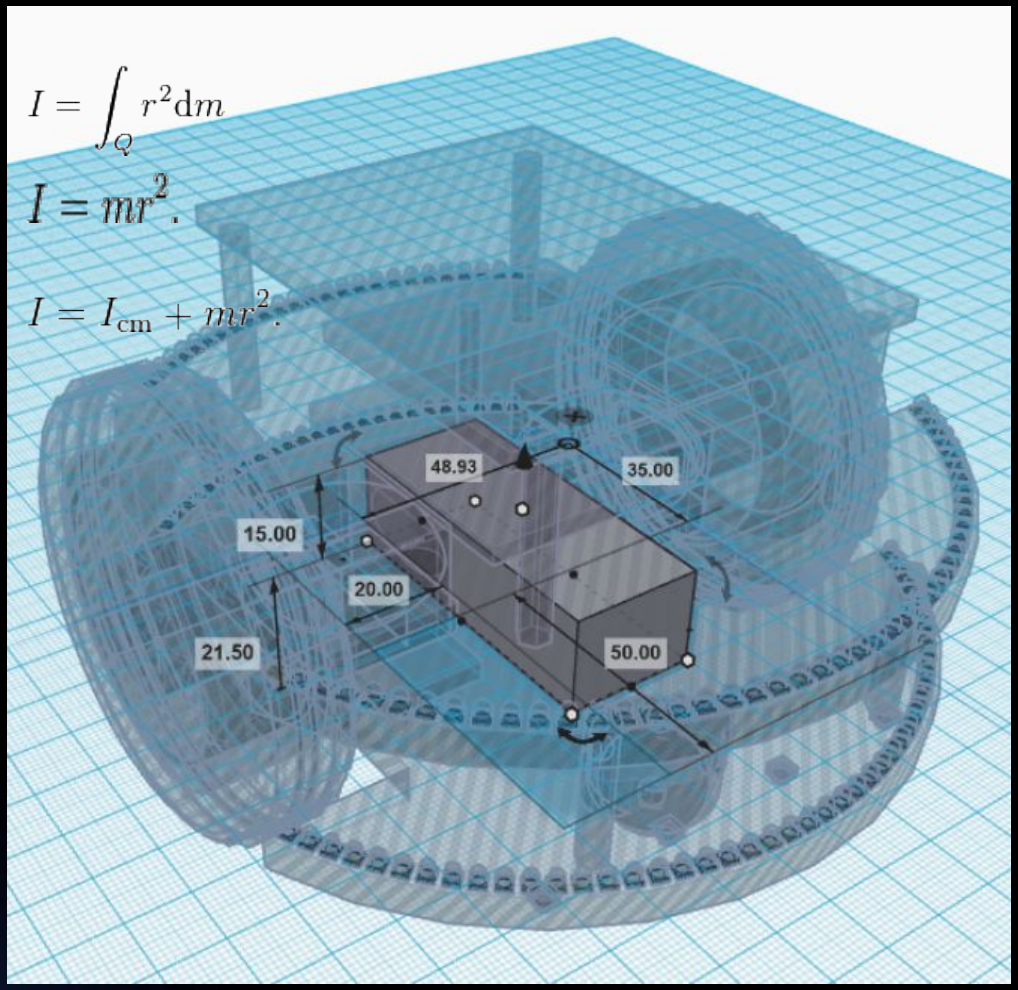
Modest Size



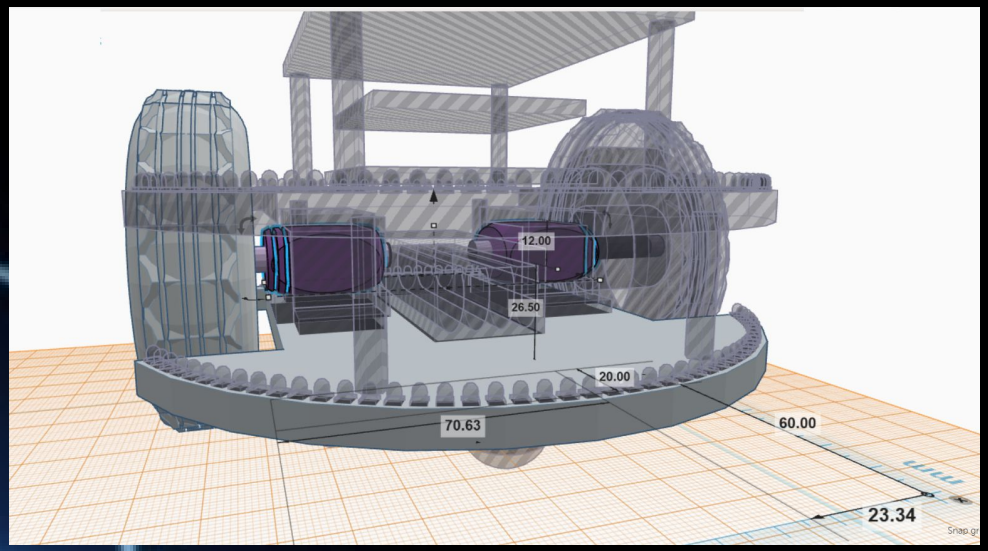
Circular Chassis

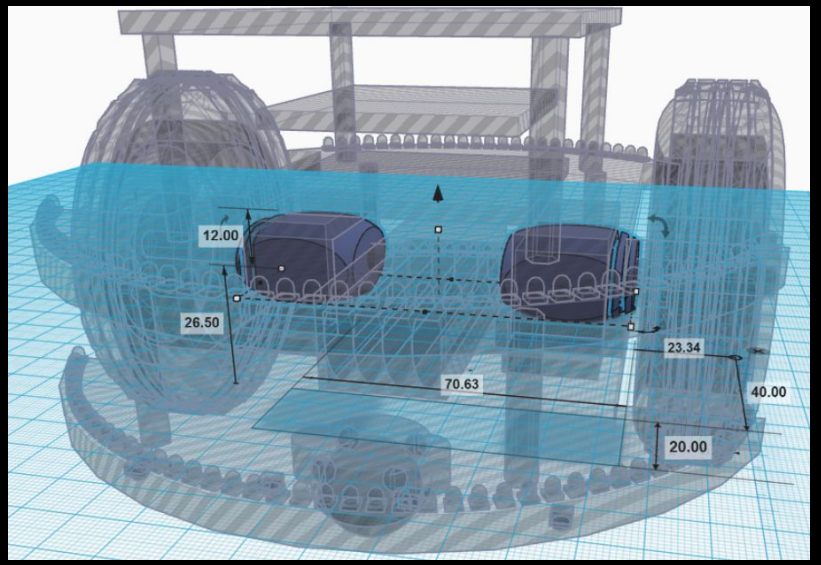


Location of the Battery

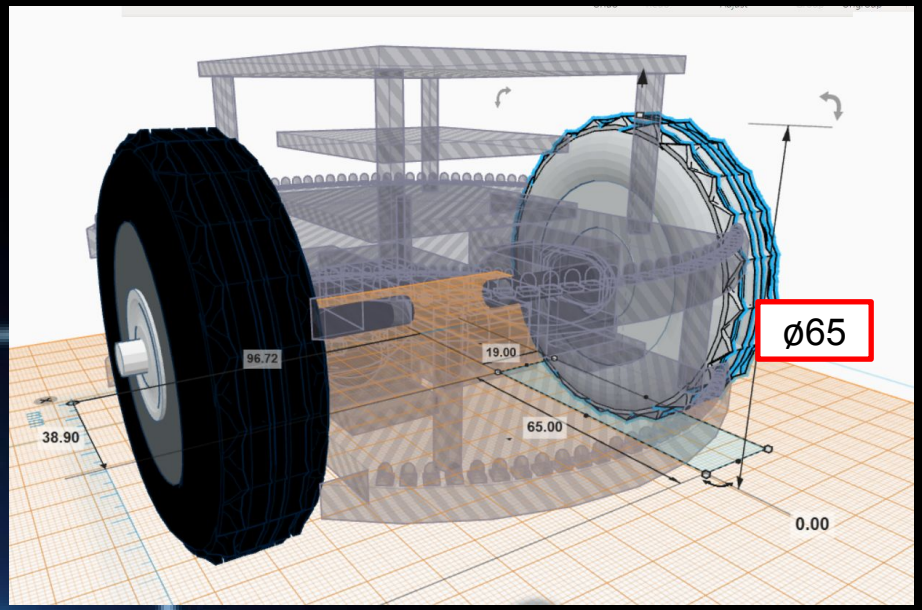


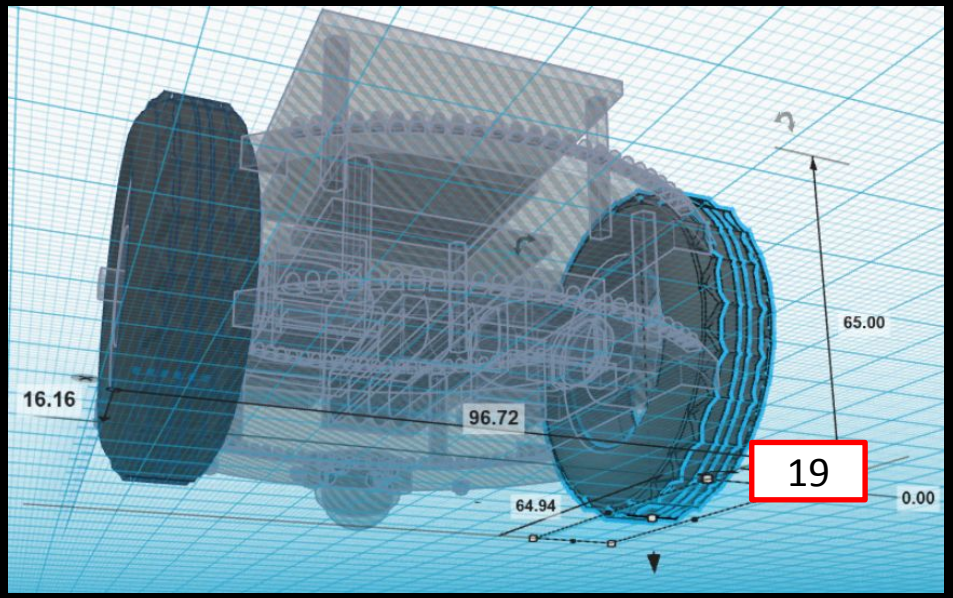
Independent Motors



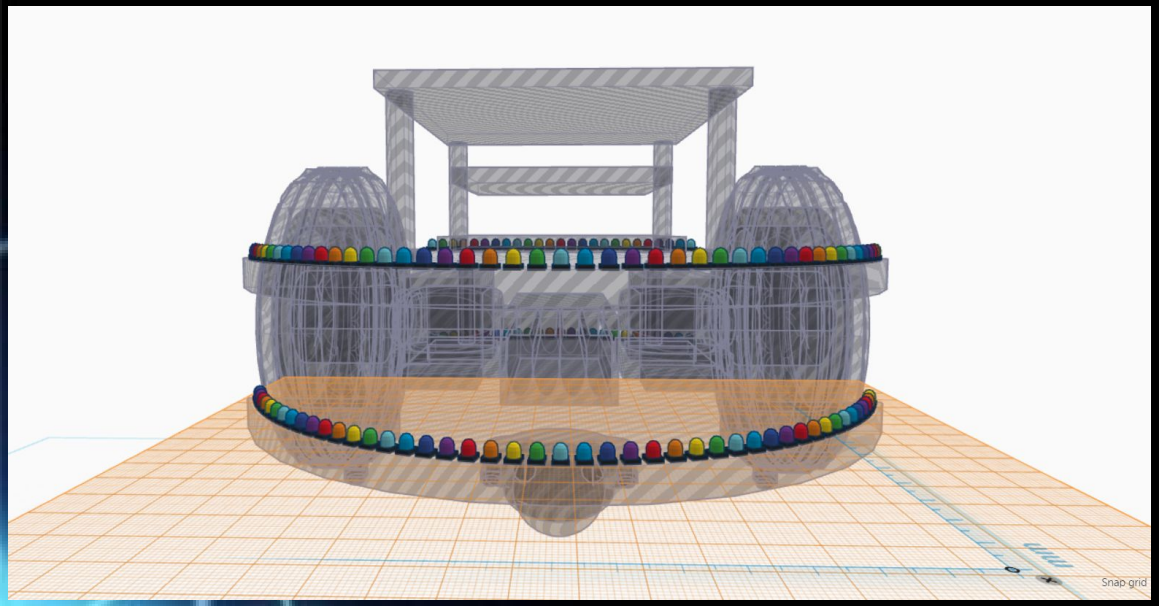


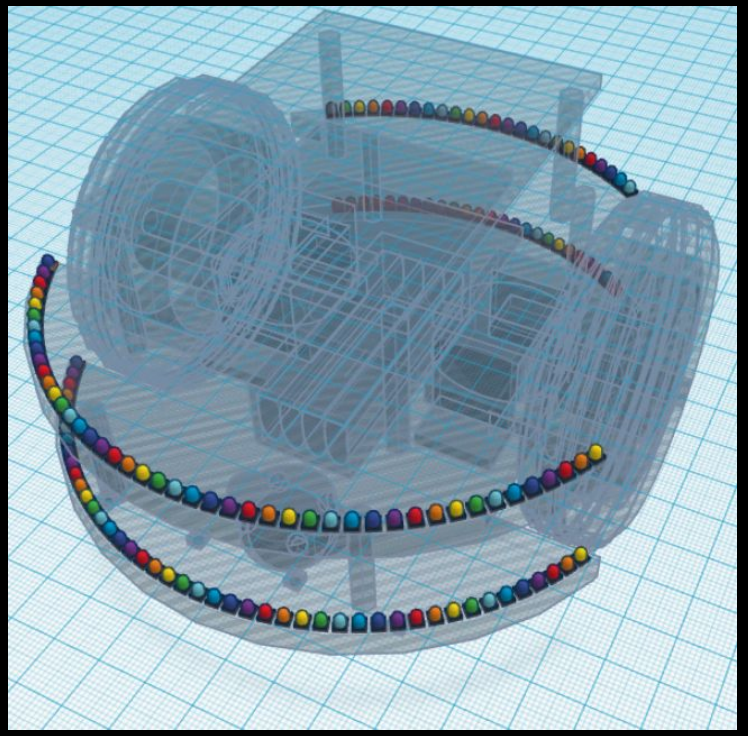
Wheel



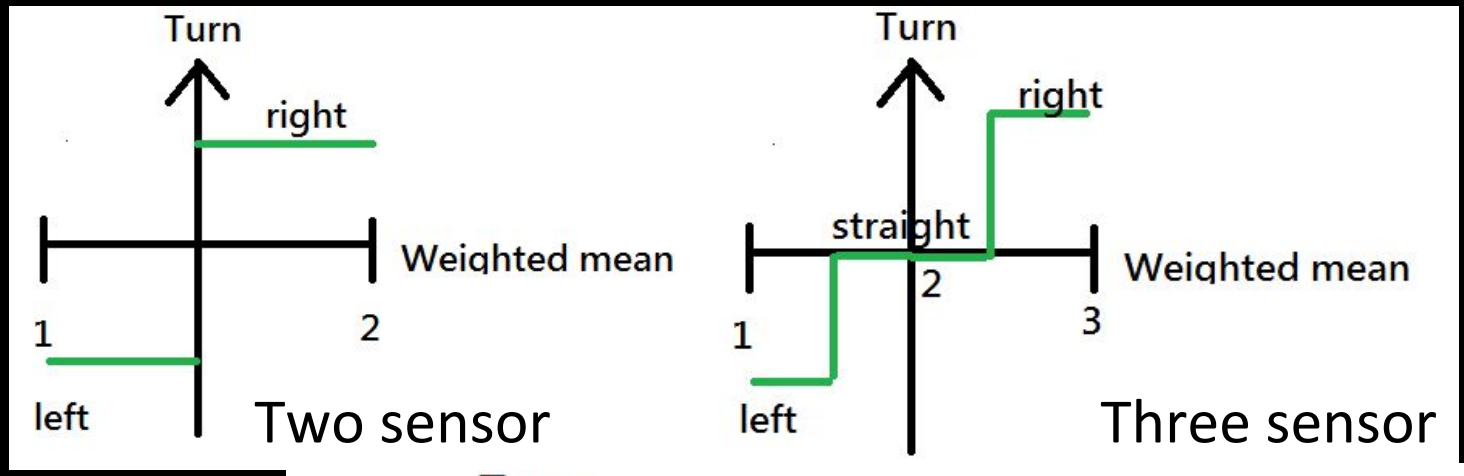


Appearance



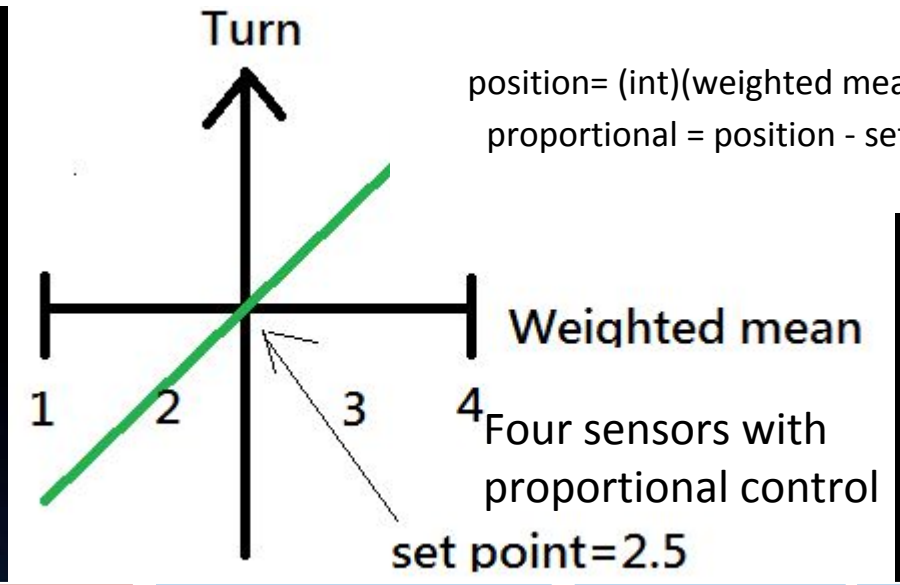


Algorithm

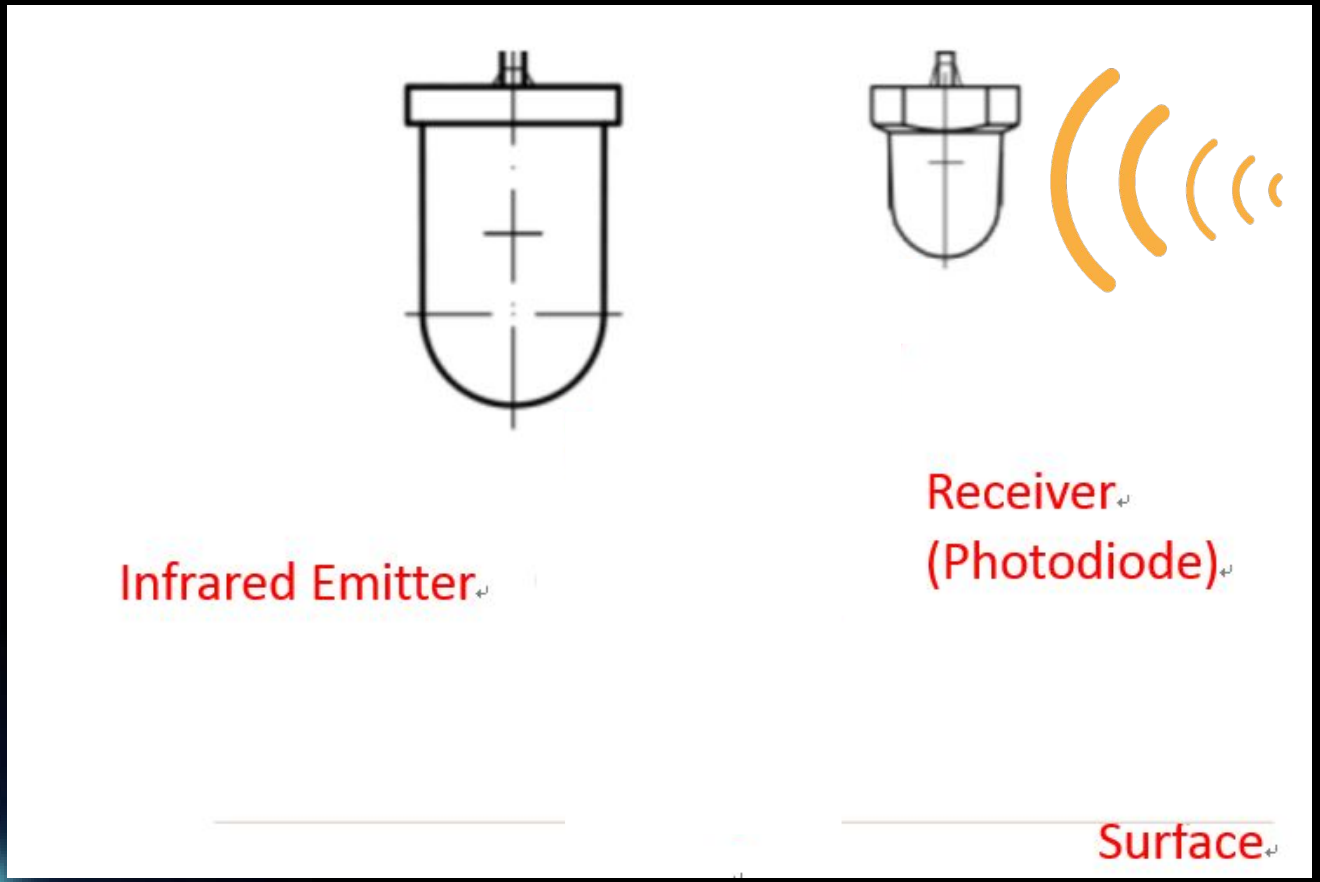


position= (int)(weighted mean*1000/sum)

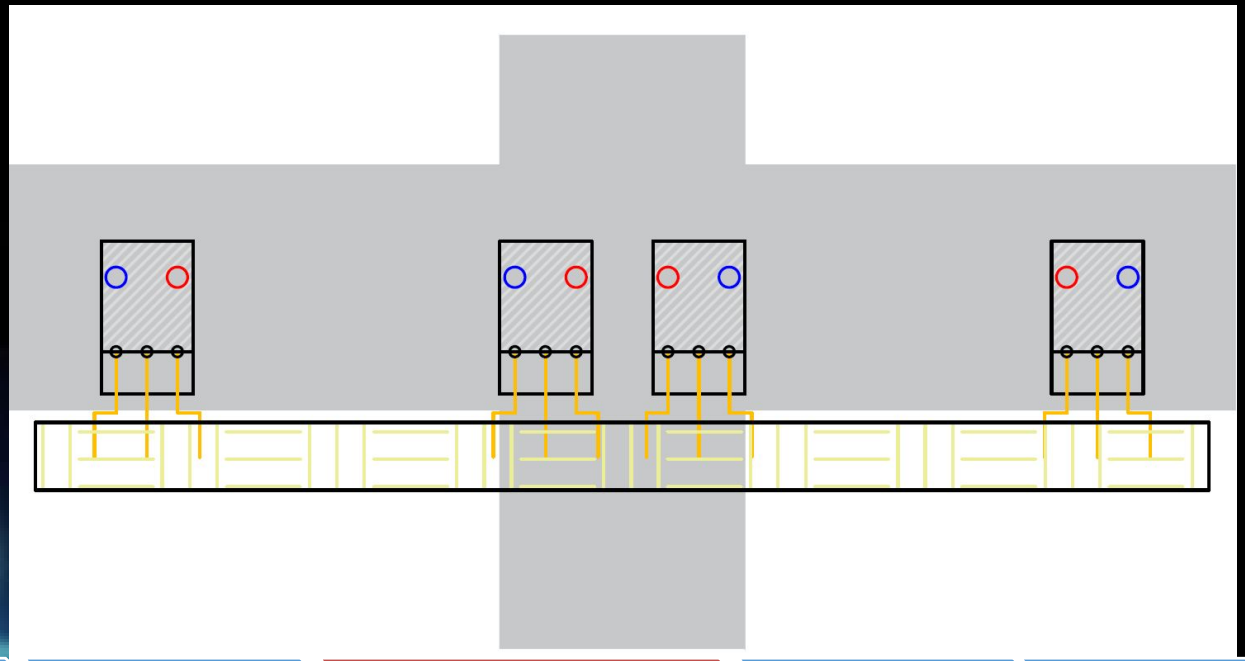
proportional = position - set point*1000



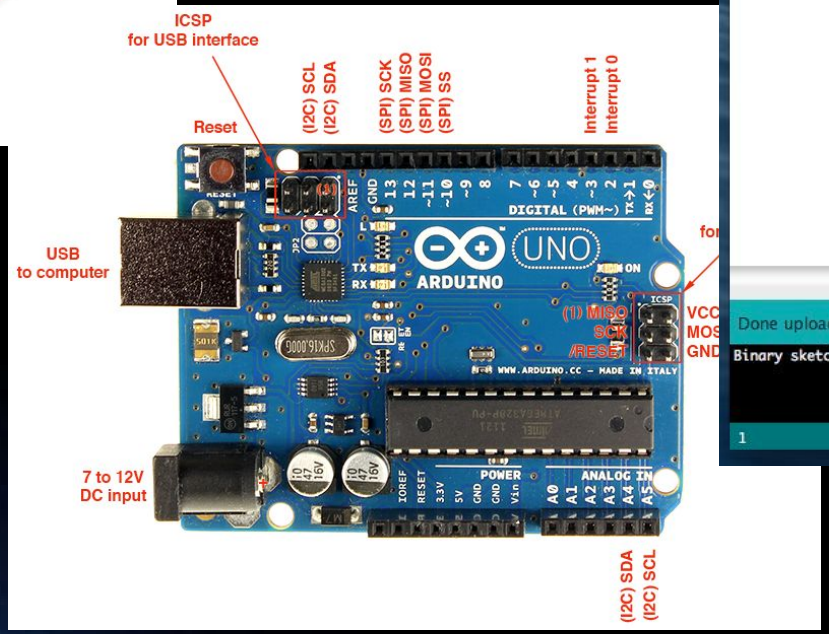
Sensor

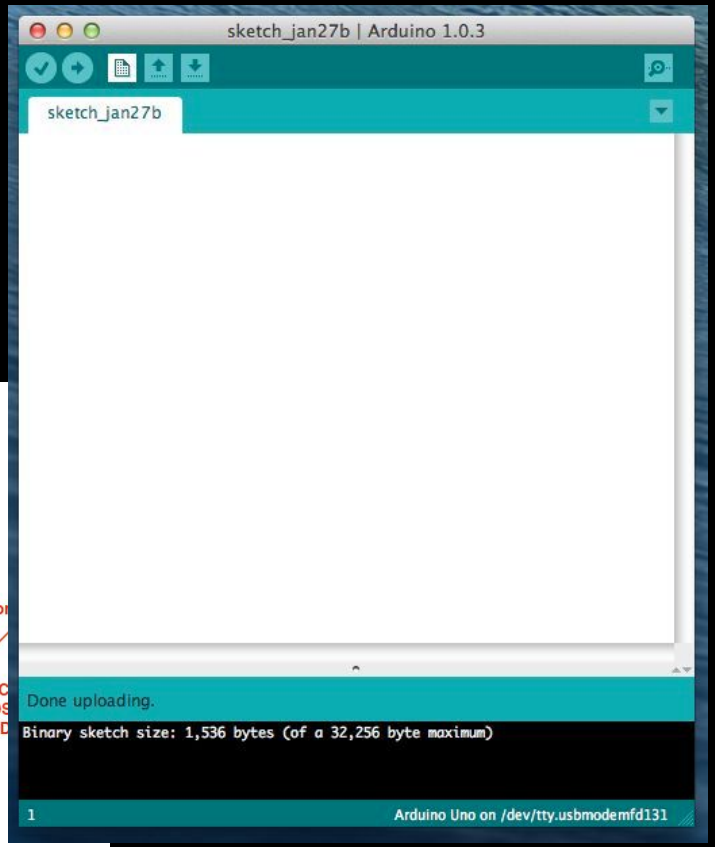


Sensor

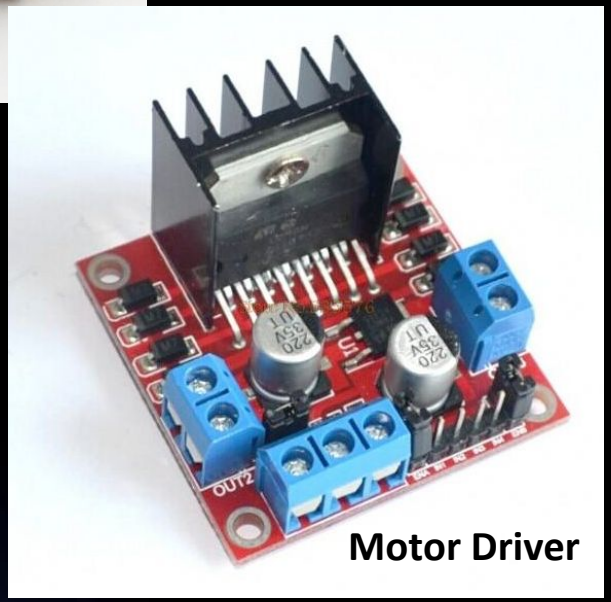


MCU (MICRO-CONTROL UNIT)





Motor



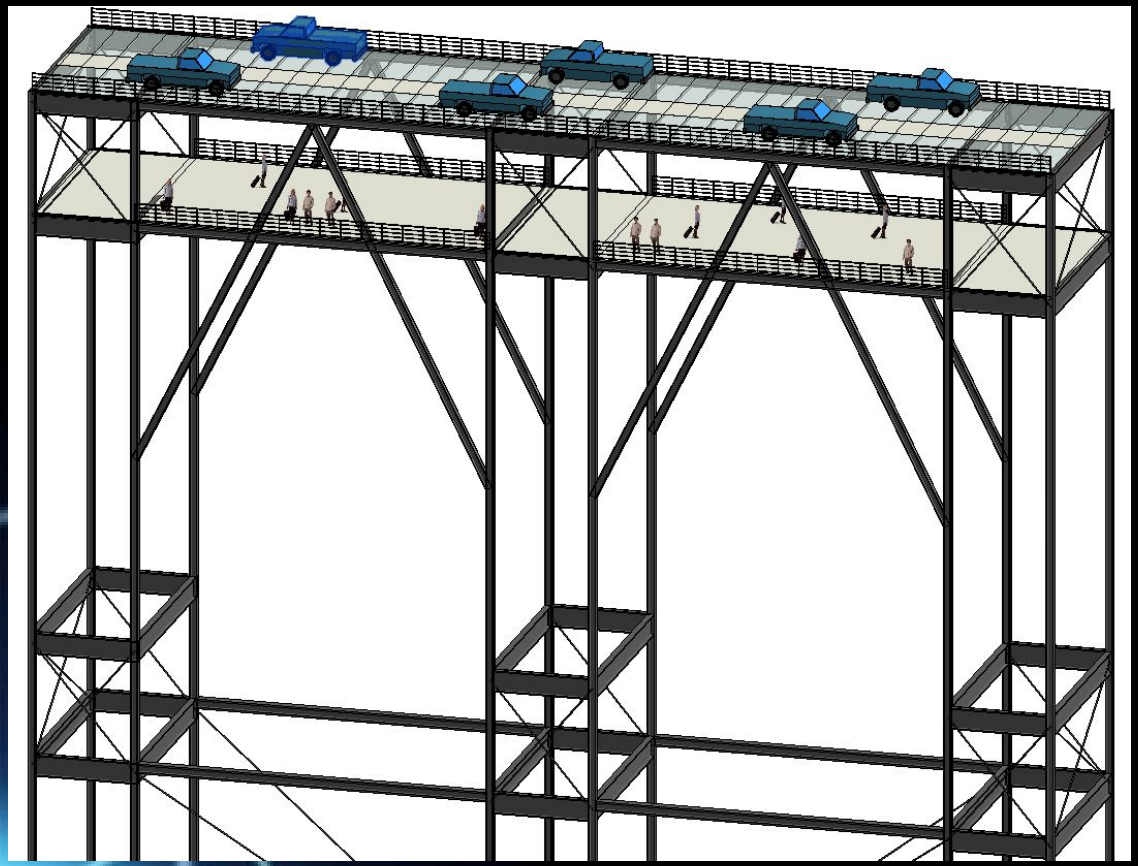
»Cheap and convenient

»Some even come with gear sets

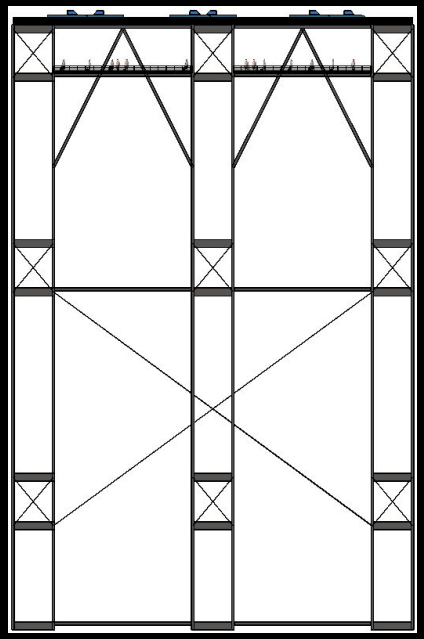
»Provides supply for motors and allow control of motors

»Current limitation of motor driver IC is 2A for L298N IC

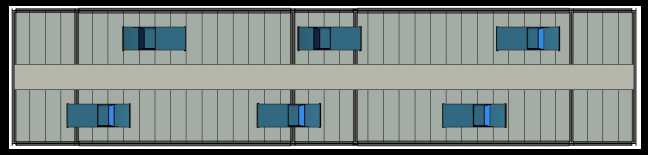
Bridge Design



Overview of Design



Elevation Views



Plan View

Bridge Design

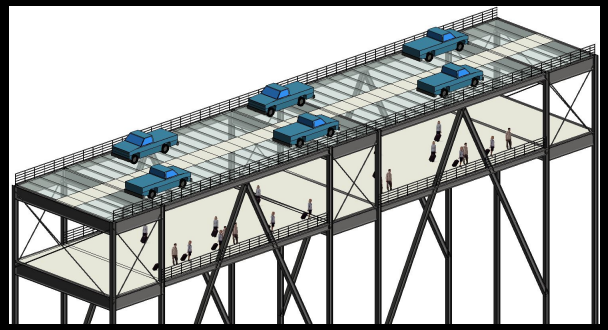
Architectural Design

Safety Design

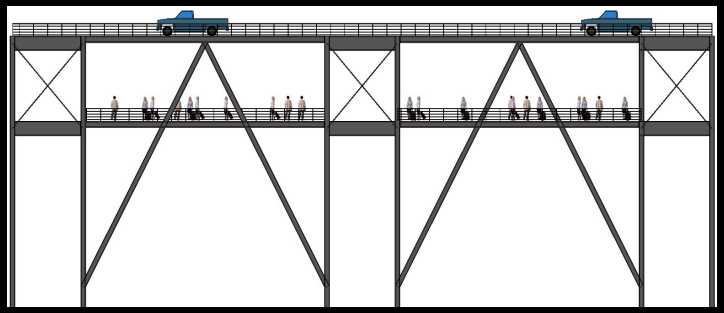
Structural Design

Alternatives

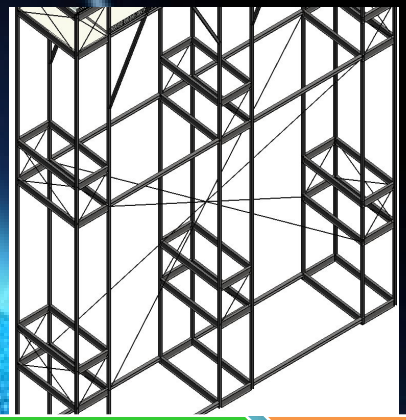
Architectural Design (BIM)



- Two roads separated by a center line
- A pedestrian bridge under the road

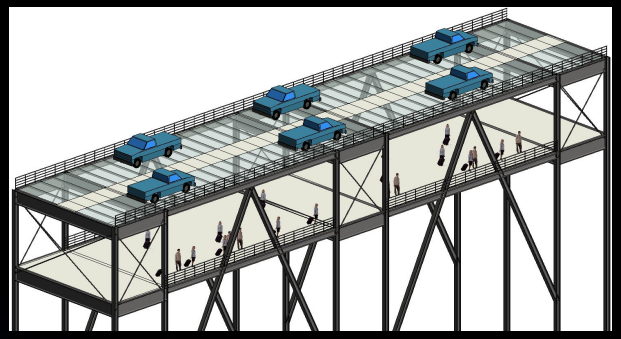


- “A” shape bracings as supports

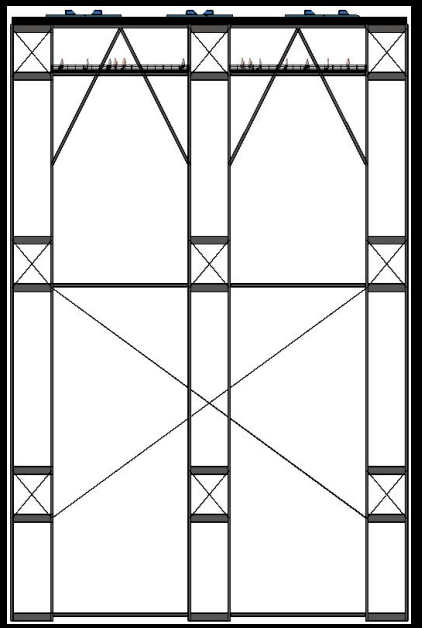


- Internal diagonal “X” bracing

Safety Design

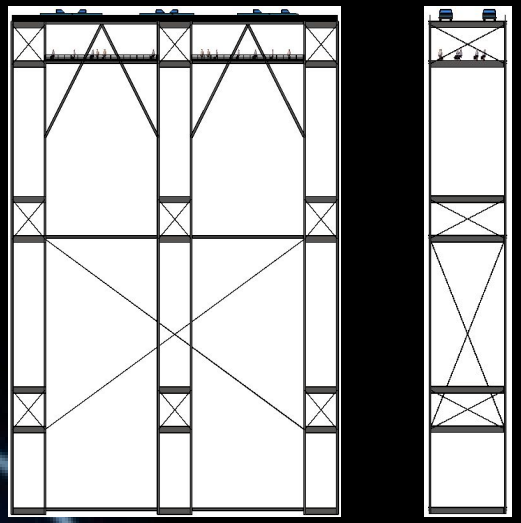


- Fencings on the two sides of the road and pedestrian bridge

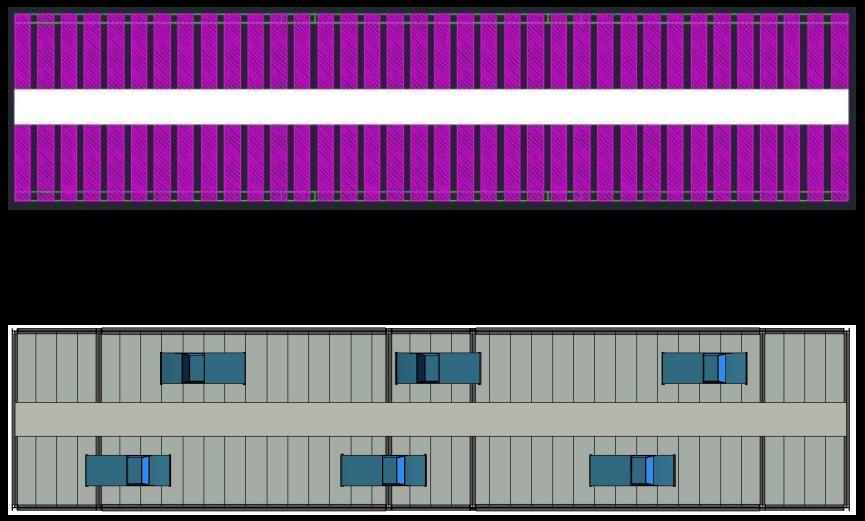


- Frame System instead of Truss System
- Redundancy of structural member

Structural Design



Elevation views

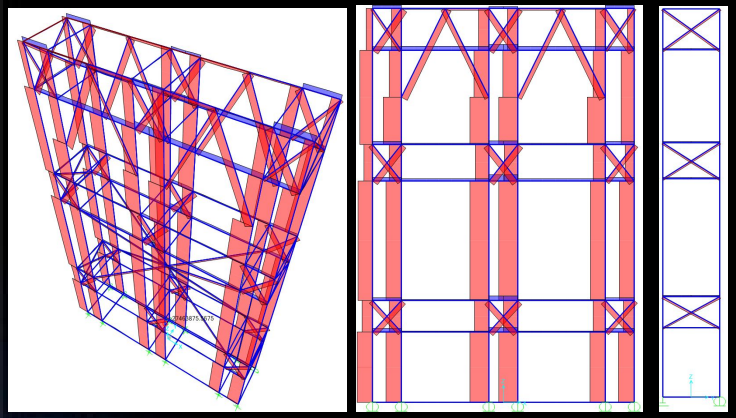


Top view

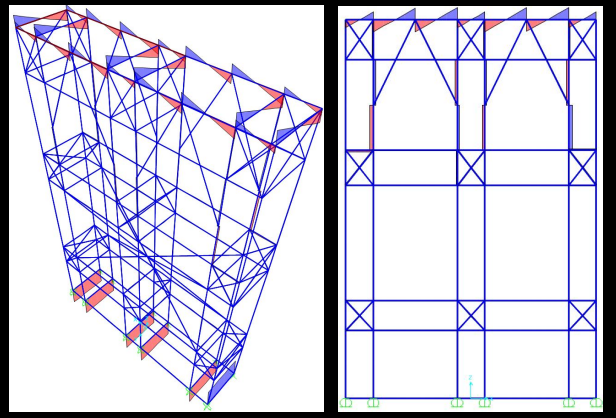
Design Assumptions:

1. Rigid connection points
2. “A” bracings only subjected to compression
3. “X” bracings only subjected to tension

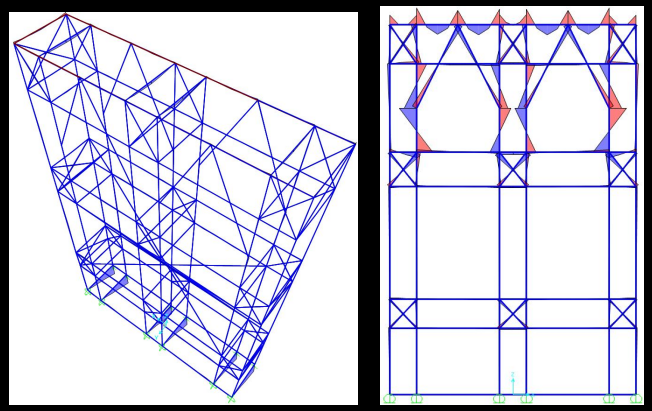
Computer Modeling (SAP 2000)



Axial Force diagram



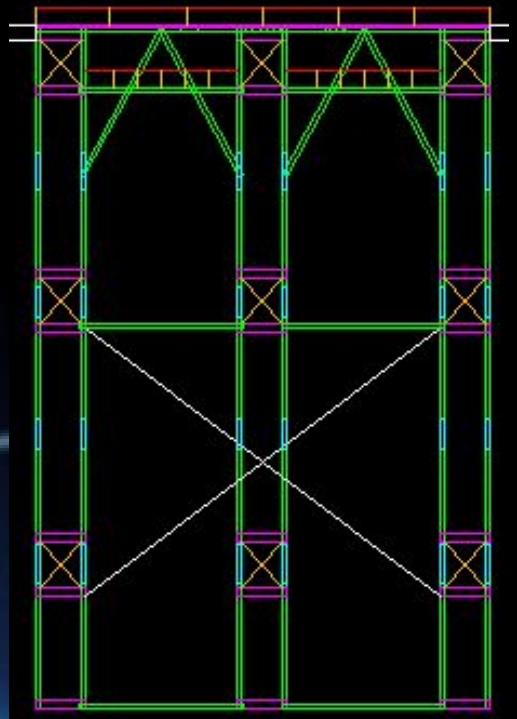
Shear Diagram



Bending Moment Diagram

Bridge Design → Architectural Design → Safety Design → Structural Design → Alternatives

Material Usage



Elevation view 1

LEDGENDS:

- STRAW
- WOODEN CHOPSTICK
- SPAGHETTI
- COTTON THREAD
- CONNECTION POINT

Spaghetti

- Rigid, sustain tension but not compression
- Used as small “X” bracings (avoid buckling)

Cotton thread

- Resist tension with infinite tensile strength (the most optimal)
- Used as a global bracing

Chopsticks

- Very rigid and stiff, able to resist compression (without buckling)
- Used as columns and “A” bracings

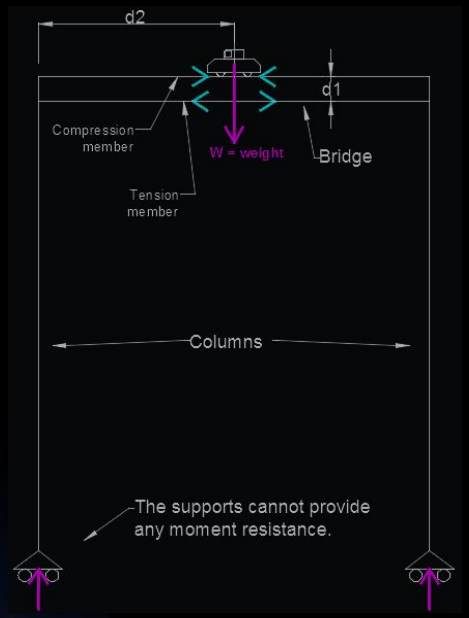
Popsicle sticks

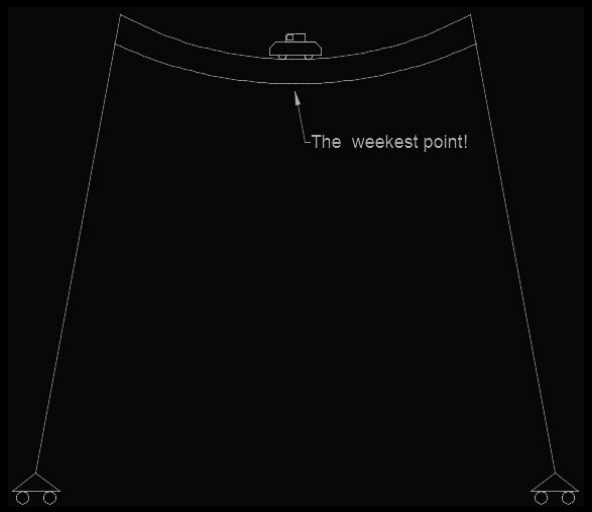
- Rigid along the long side, anisotropic material
- Used as beams and slabs on the road.

Tapes, AA

- Wrap the tape around connection points
- Inject Aron Alpha inside the tape
- Form rigid joints.

Structural System Design





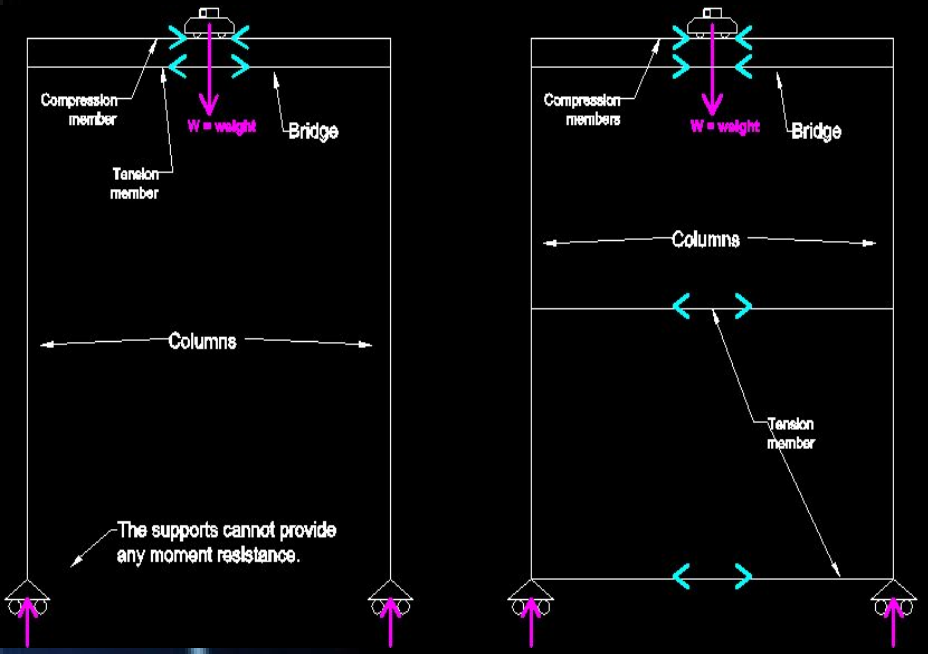
Conventional design of viaduct

Problem:
Very high overturning moment (roller supports)

Result:
1. Structural Failure (May break easily)
2. Severability Failure (Large deformation)

Bridge Design → Architectural Design → Safety Design → Structural Design → Alternatives

Structural System Design

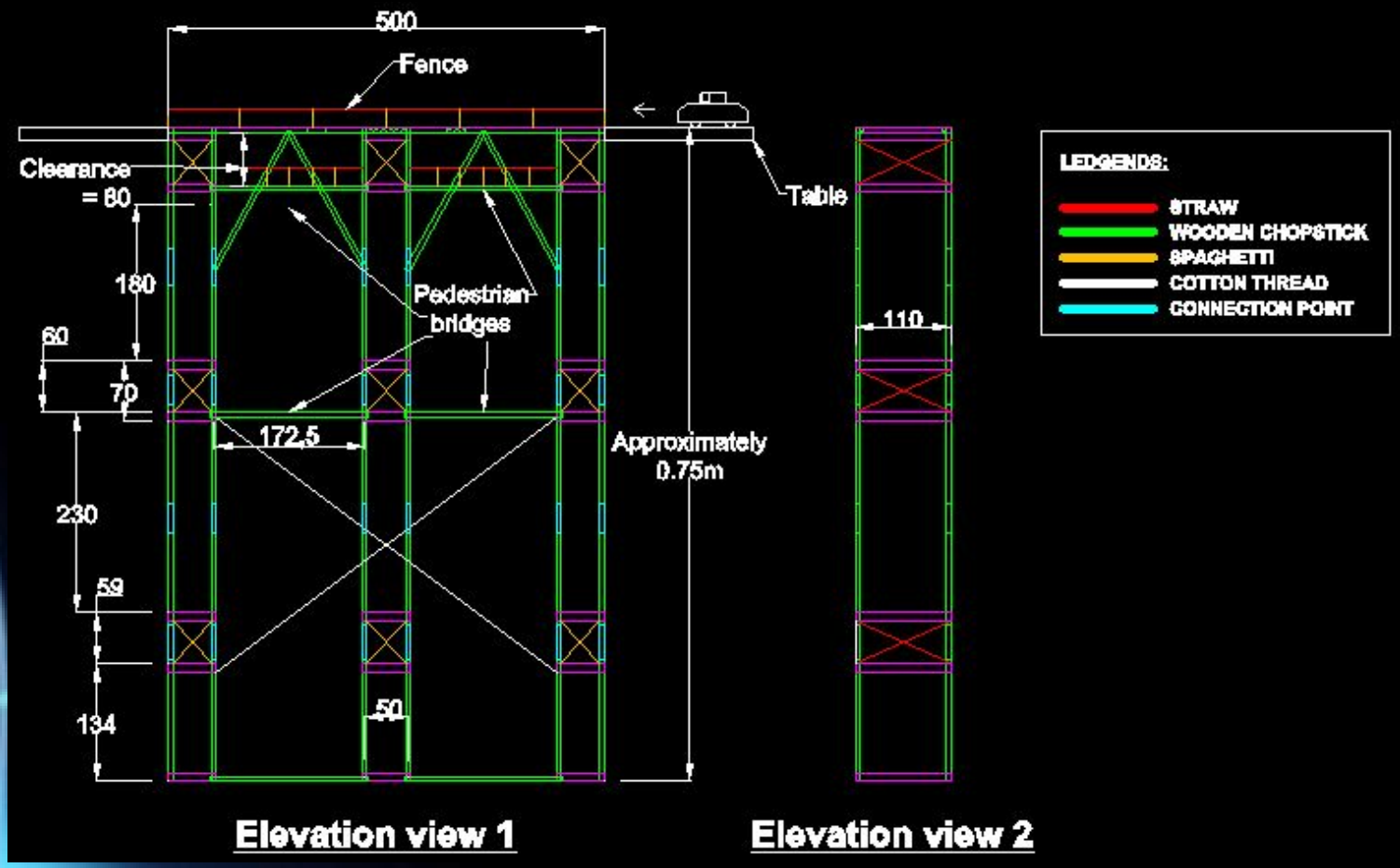


Proposed Design of Viaduct

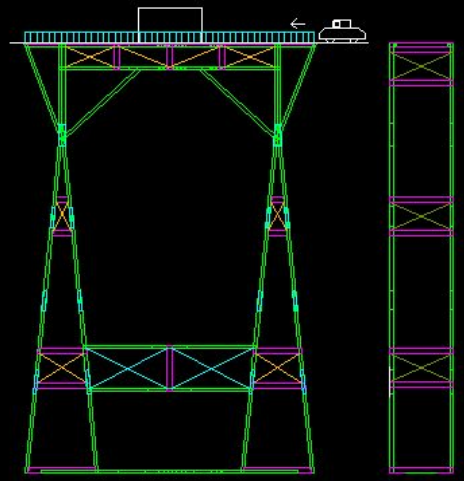
Design Principle:

1. Minimize the span length (by "A" bracings)
   - Reduce overturning moment
2. Global bracing
   - Stiffen the entire structure
3. Small "X" bracings
   - Avoid column deformations
4. Rigid connection (Fixed ends)
   - Provide additional moment resistant strength

Structural Design



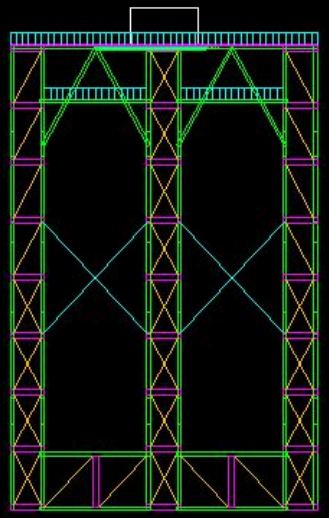
Alternative Design



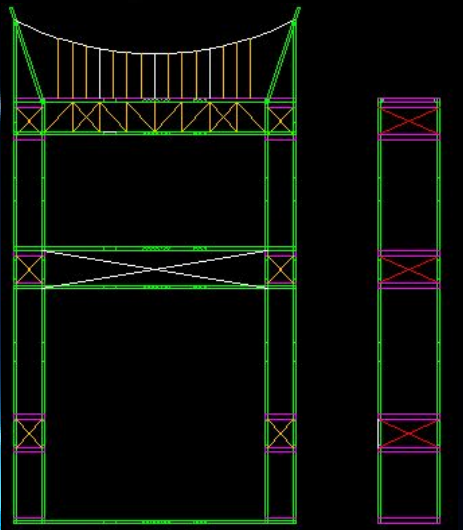
Viaduct bridge design 2

LEDGENDS:

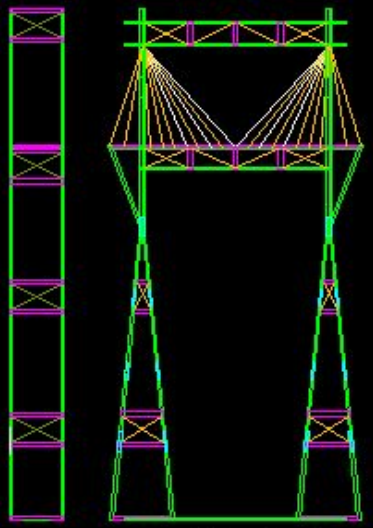
- STRAW
- WOODEN CHOPSTICK
- SPAGHETTI
- COTTON THREAD
- CONNECTION POINT



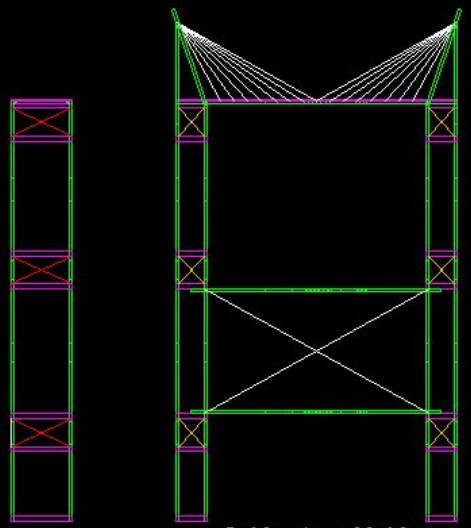
Truss system



Suspension bridge



Cable-stayed bridge



Cable-stayed bridge design 2

Bridge Design → Architectural Design → Safety Design → Structural Design → Alternatives


Thank You