Rero, Robotic; Advanced Application of Mechanical, Electrical Machines and control Engineering

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1.1 INTRODUCTION

- The robots are innovative gear utilized as a part of regular life need noteworthy ability to be created and a huge extent of the creation expenses of these gadgets originates from the skill.

- Rero run with lose parts which attract client's robot building inventiveness and imaginative essentialness.
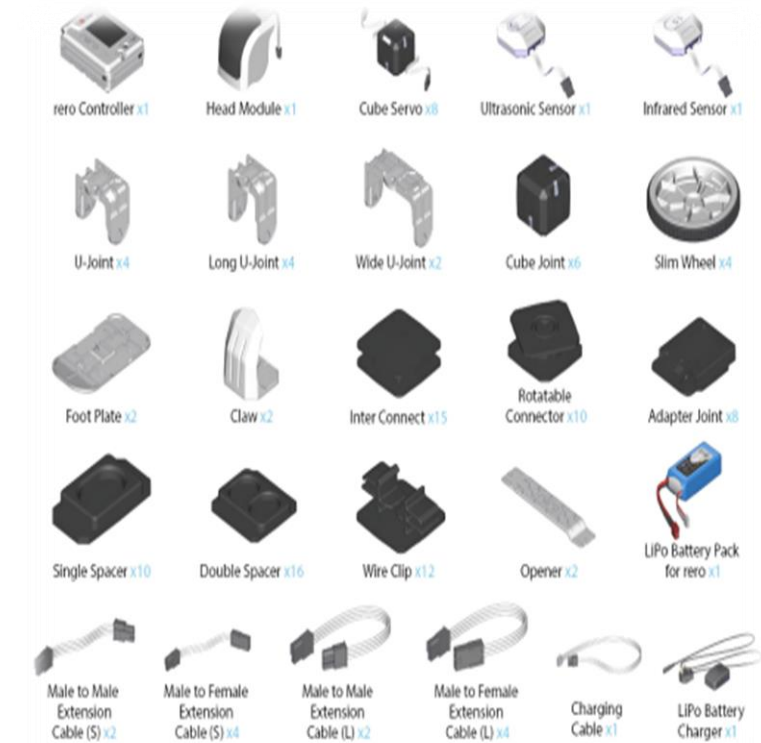
Example robot assemblies with rero

Commercial robots can perform assignments just when they have been given an exact and point by point set of guidelines for completing those errands .

1.3 INTRODUCTION – Product Features

- Reconfigurable robot construction kit.

- Assembling and dismantling of robot really easy and fast.

- 3.2" TFT color LCD with touch screen.

- 360^0 endless electrical rotation.

rero Controller x1	Head Module x1	Cube Servo x8	Ultrasonic Sensor x1	Infrared Sensor x1
U-Joint x4	Long U-Joint x4	Wide U-Joint x2	Cube Joint x6	Slim Wheel x4
Foot Plate x2	Claw x2	Inter Connect x15	Rotatable Connector x10	Adapter Joint x8
Single Spacer x10	Double Spacer x16	Wire Clip x12	Opener x2	LiPo Battery Pack for rero x1
Male to Male Extension Cable (S) x2	Male to Female Extension Cable (S) x4	Male to Male Extension Cable (L) x2	Male to Female Extension Cable (L) x4	Charging Cable x1	LiPo Battery Charger x1

Features of product(ex-mechanical and other functional properties)

1.4 INTRODUCTION –Applications

- Robots are deployed in areas where human being could not survive or be exposed to unsustainable risks.

- Service Applications: Robots are used in civil applications such as intelligent transportations, patient rehabilitation system.

- Medical applications, domestic aid, entertainments etc.

2.0: Mechanical Part Manufacturing processes and selection of materials

There is a ton of choice concerning picking the building materials for your robot. However not every material is a right decision. There are several sorts of suggested materials.

2.1: Materials selection and consideration

- **Wood**

  Useful for little or medium measured robots, prototyping and as advancement instrument(e.g Kevlar is a brand name. It's made of Aramid)

- **Metal**

  There are 80 various perfect metals each having unmistakable properties. However in the domain of Robotics there are simply a picked few from the 80 that are useful.

Materials selection and consideration

- **Aluminum**

1-Useful for little or medium evaluated robots.

2-Useful for non-load bearing parts in generous robots.

3-Not useful for direction.

There is a compound of aluminum called Duraluminium. it is as strong as sensitive steel yet light accordingly settling on it a trademark choice for the improvement of Aircraft.

Materials selection and consideration

- **Steel**
- Typically available steel is a mix of iron. It's stronger than aluminum, however in the meantime its heavier and harder to work with – particularly
- Useful for huge robots and robots proposed to work in harsh conditions. Too substantial for little or medium measured robots.

- **Bronze**
- Useful for heading

- **Brass**
- Useful for direction.
- Useful for orientation.

- **Copper**
- Basically accessible as wire

Materials selection and consideration

- **Composite materials**
- Polymer composite materials will be materials comprising of a polymer lattice and a fortifying material. (Fortified cement: the polymer framework is the steel lattice and the strengthening material is the cement) .Polymer composite materials is the suitable one to manufacture rero body
- These materials are extensively stronger and stiffer than steel and aluminum combinations.

  Composites are just utilized where weight is a more critical variable than cost, e.g., planes: less weight implies less fuel utilization and/or more helpful payload.

2.2: Forming Strategies-Processing manufacturing of a motherboard
2.2.1 : **SMT** (**Surface Mount Technology**)

1- Solder Paste Screen Printing

The solder paste: particles of solder suspended in flux

Mixing and applying the solder paste to the nickel screen
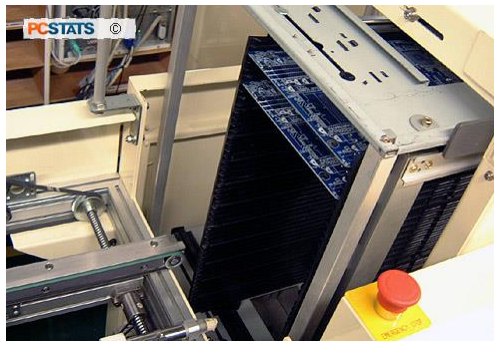
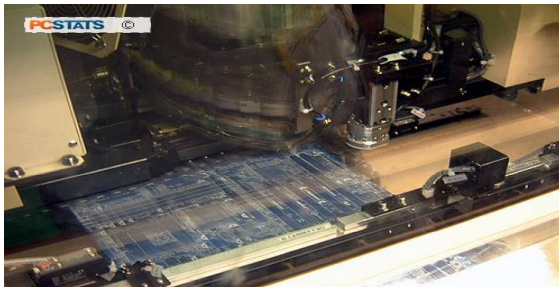Solder printed motherboards awaiting the **SMT** process
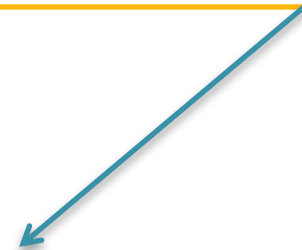
2- SMT Assembly Line

Gigabyte's SMT production lines

The FUJI pick and place SMT machines mount components on each motherboard
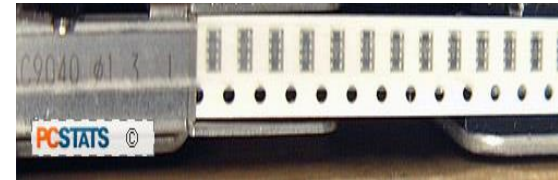
components are fed into the SMT machines from tape-like reels

Each of the 16 or so heads places a different component in as little as 1/8 of a second (flash frozen in this picture)

An SMT machine about to start placing components on a motherboard

SMT Process Continues

A motherboard part way through the SMT process. Large ICs have yet .

3- Pick and Place Chipsets

Processors sockets are set up so that they can be picked up by the machine and placed on the PCB

Large JUKI KE-2010L SMT chip machine. Chips are grabbed from a tray at upper left.

- Each IC is visually inspected by the machine with small light boxes to ensure no defects in solder leads or solder balls
- The IC is then carefully placed on the PCB. It takes 1-2 seconds per large IC component.
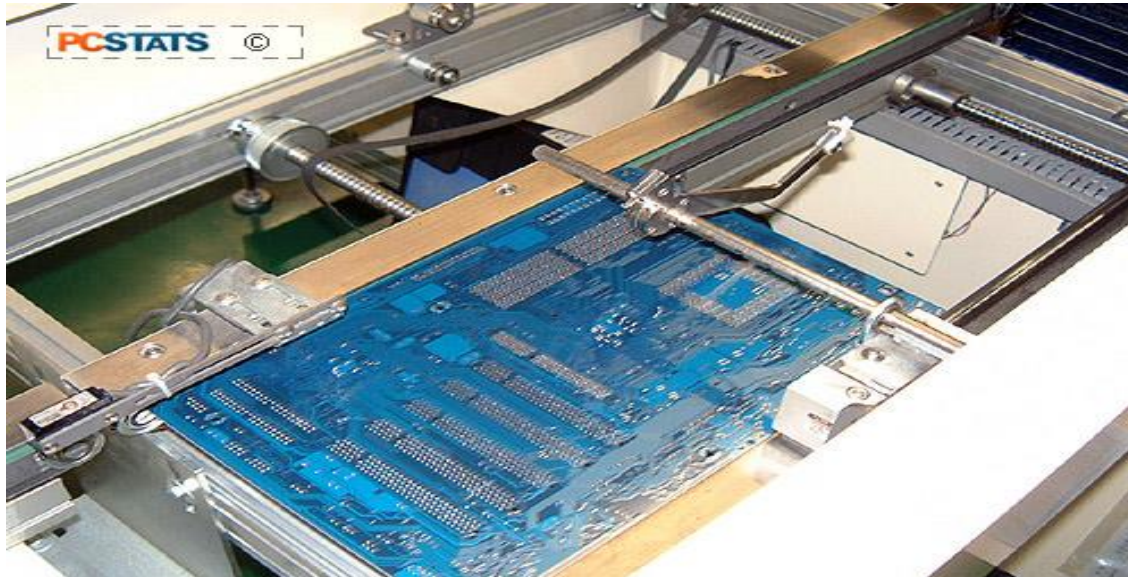
Flip side SMT line

With all the IC parts set on the PCB, the motherboards have experienced a Heller 1900EXL hot air convection reflow stove to weld everything set up.

5- In-Circuit Testing and Visual Inspection
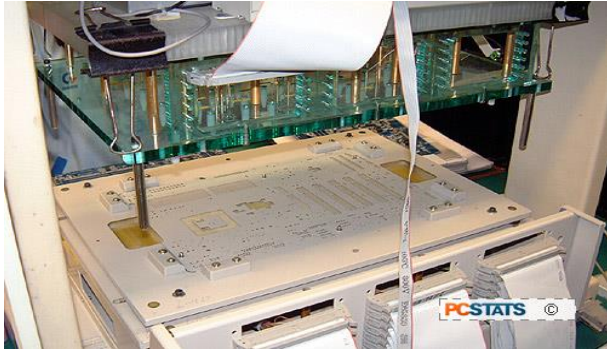
The Gigabyte in-circuit electronic test bed
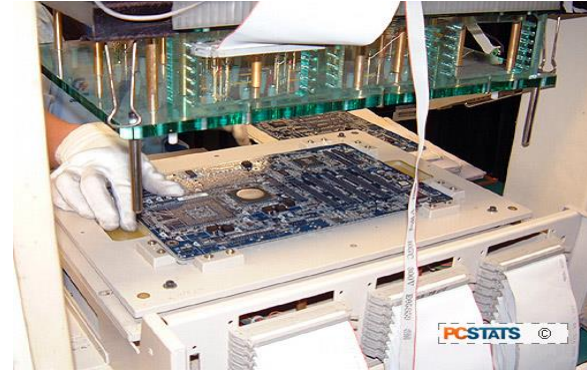
Each board is mounted on the test bed
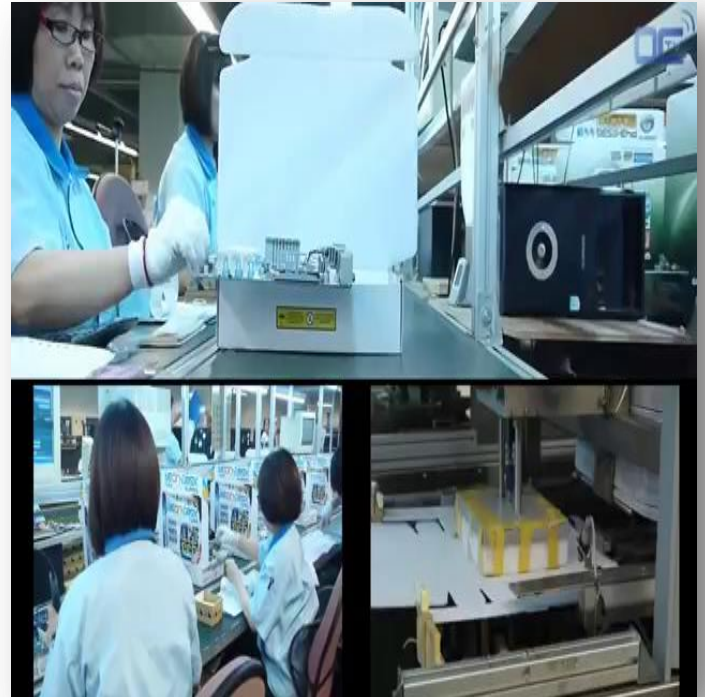

Assorted spare test rigs gathering dust on a shelf

· **A different rig is needed for every motherboard model Gigabyte produce. This in-circuit tested is for the Gigabyte GA-8KNXP motherboard.**

The rack is lowered, making contact with test points on the board

6- DUAL IN –LINE PACKAGE (DIP)

1- wave soldering

2- tasting stage

3- packing stage

2.2.2: Advantages and Disadvantages of Surface Mount Technology(SMT)

- **advantages**
- Few holes need to be drilled onto the circuit board.
- Costs and budgets are reduced as the parts often cost less than their equivalent through-hole parts.
- Components can be placed on either side of the circuit boards, which is beneficial.
- The components of SMT are smaller.

- **disadvantages**
- The manufacturing process for SMT however, requires positioning of parts of un-perforated boards instead of accurate drilling of many holes.
- Large, high-power or high-voltage parts are unsuitable for SMT. This requires the process of combining SMT and through hole construction.
- Manual prototype or component level repair is more difficult as it requires the use of skilled operators and expensive tools as the parts are much smaller.

2.3: SHAPE DEPOSITION MANUFACTURING of grasper fingers (SDM)

- Shape Deposition Manufacturing (SDM) is a quick prototyping methodology including a cycle of affidavit of part material and forming that develops the part in unmistakable layers.

- The polymers used are two-area mechanical polyurethanes. Various pieces are used for the fragile fingerpads, pleasing joints, and firm associations (IE35A, IE90A, and IE72DC, separately, Innovative Polymers, St. Johns, Michigan, USA).

MATERIALS SPECIFICATIONS

	IE20AH	IE35A	IE90A	IE72DC
Hardness	15-25A	30-40A	85-95A	75-85D
Tensile Strength ASTM D-638 (ksi)	0.2	0.4	1.8	10
Elongation at Break	175%	470%	100	2%
Tear Strength ASTM D-624 (pil)	25	50	250	N/A
Flex Modulus ASTM D-790 (ksi)	N/A	N/A	N/A	325
Ultimate Flex Strength D-790 (ksi)	N/A	N/A	N/A	13

Table shows material properties as gave by the maker

SHAPE DEPOSITION MANUFACTURING of grasper fingers (SDM)
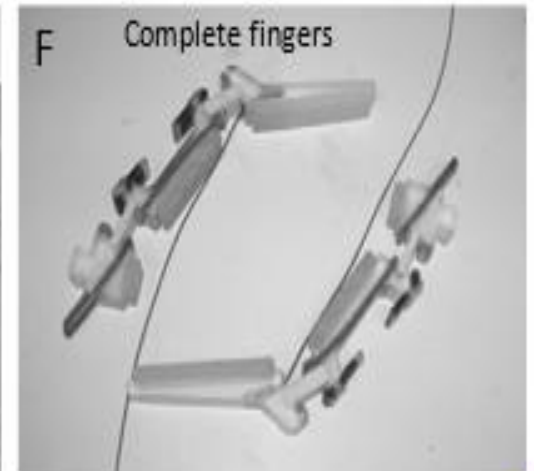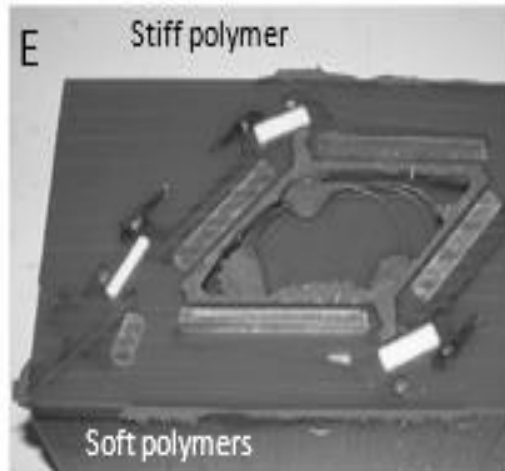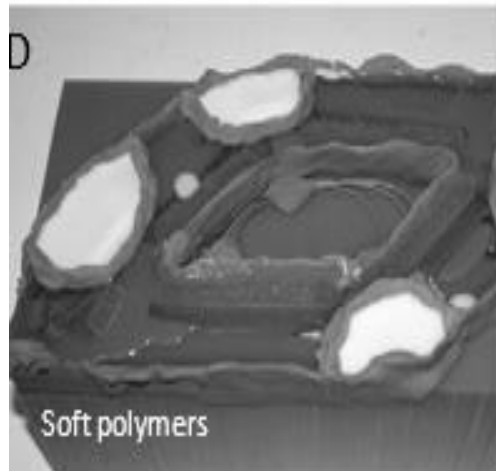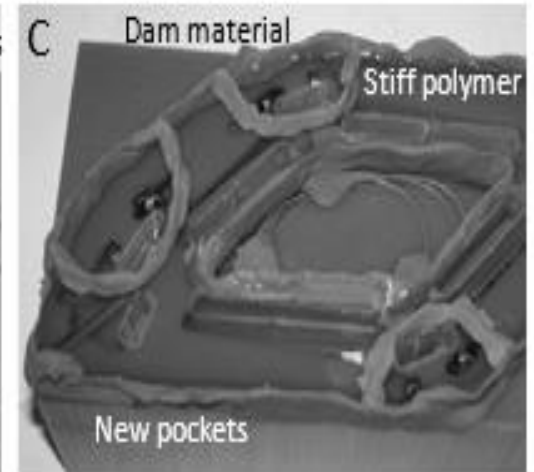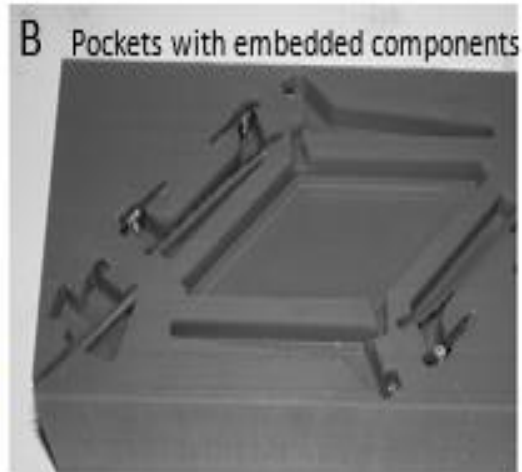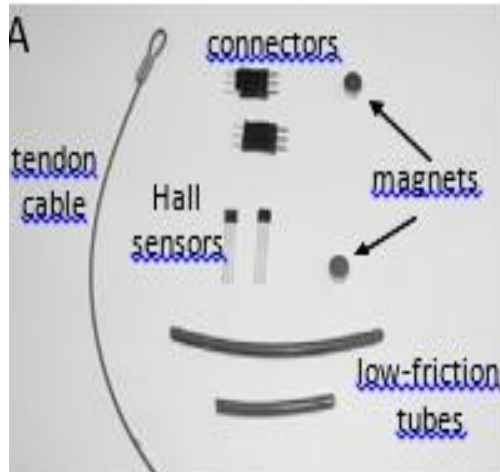
2.4:Symbols of manufactured mechanical parts

Wide U-Joint
RR-UJ-03
O 260
RM15.90
Add To Cart

Cube Joint
RR-CJ-01
O 48
RM18.02
Add To Cart

External Joint for G15
RR-EJ
O 1709
RM8.48
Add To Cart

Mechanical parts

Double Spacer
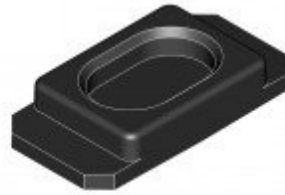RR-SF-02

O 1488
RM1.59
Add To Cart

Single Spacer
RR-SF-01

O 3858
RM1.59
Add To Cart

Opener
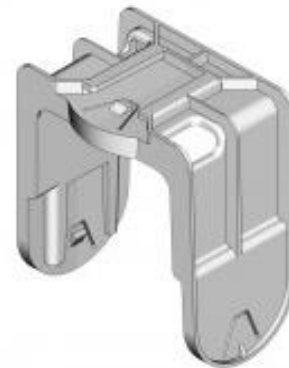RR-CO-01

O 1736
RM6.36
Add To Cart

Mechanical parts

U Joint
RR-UJ-01
O 115
RM13.78
Add To Cart

Long U-Joint
RR-UJ-02
O 151
RM15.90
Add To Cart

3.0: Electrical Machines are used by Robot

DC Motor

VEXTA DC Brushless Motor ➕
DC Brush Motor ➕
DC Geared Motor ➕
Servo Motor
Toy Motor
Stepper Motor
Linear Motor
Automobile DC Motor
Ampflow Motor

G15 Cube Servo

G15 Cube Servo is a modular smart serial servo which incorporates gear reducer, precision high torque DC motor and control circuitry with networking functionality. It is made with high quality engineering plastic to provide high necessary strength and is able to sustain high external force up to 15 kg.cm. holding torque. G15 provides 360^0 endless electrical rotation by using potentiometer to lead itself to solve some application such as to motorize a mobile robot. G15 also has LED indicator to show the status of the servo.
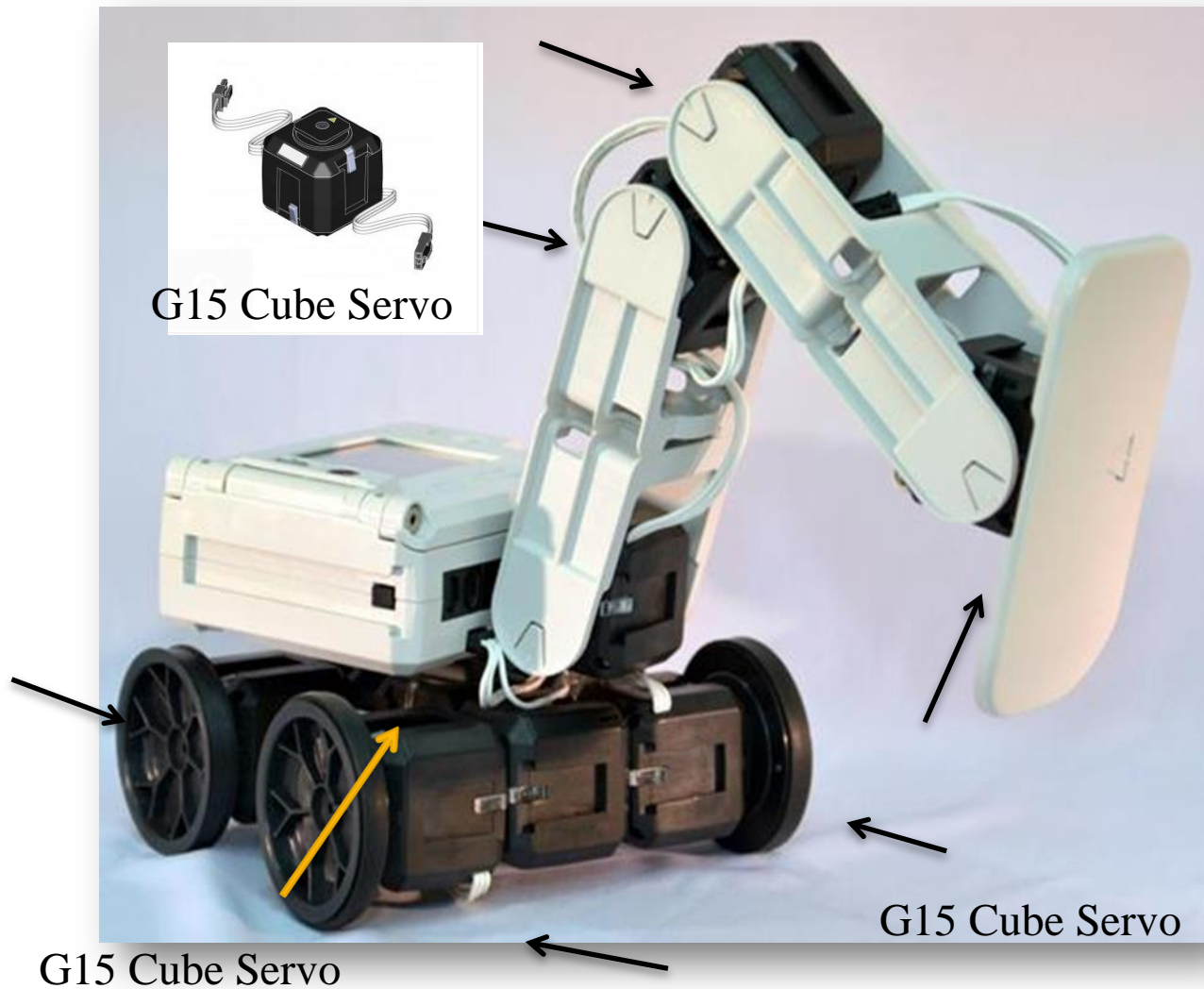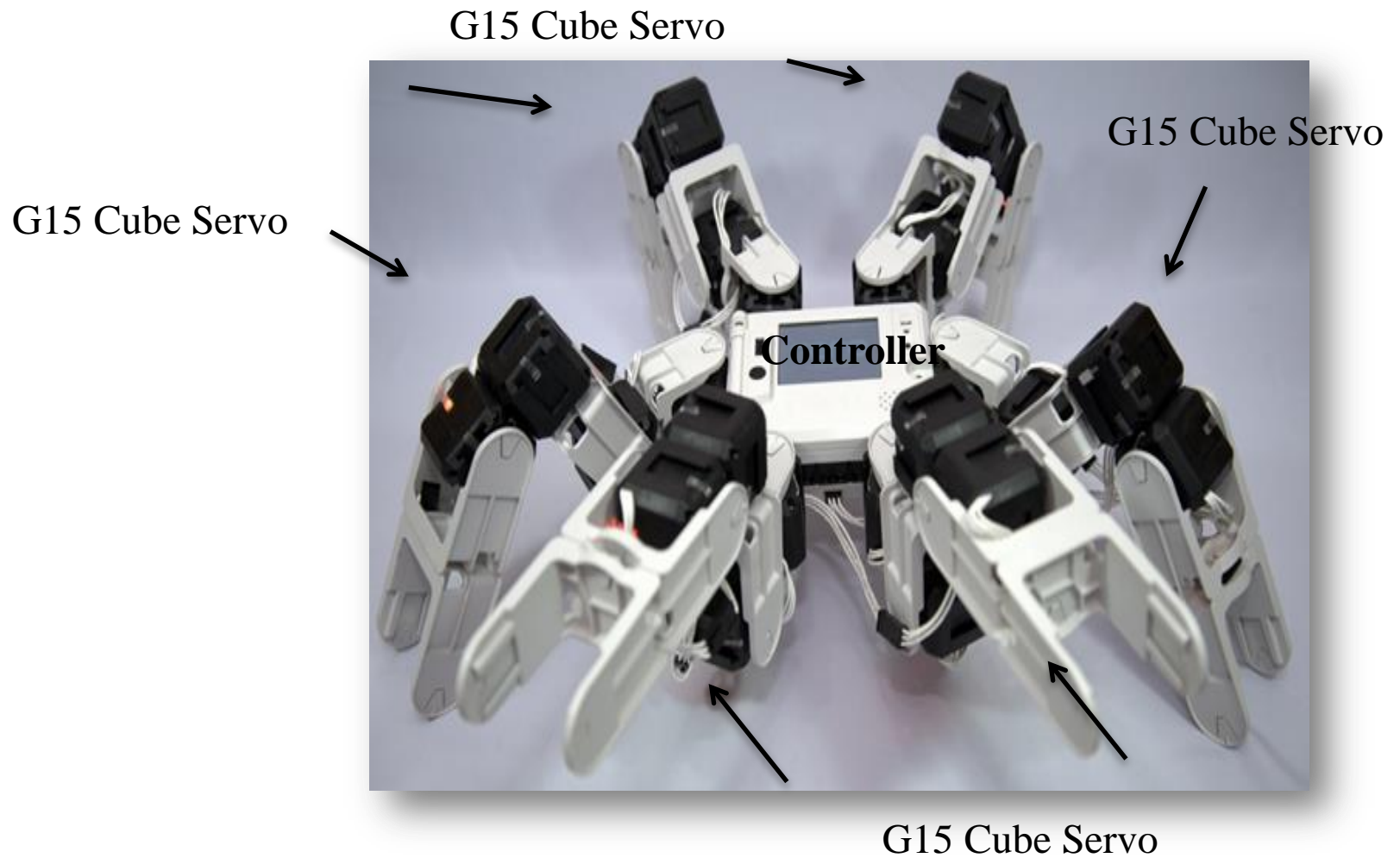

G15 Cube Servo

G15 Cube Servo

G15 Cube Servo

G15 Cube Servo
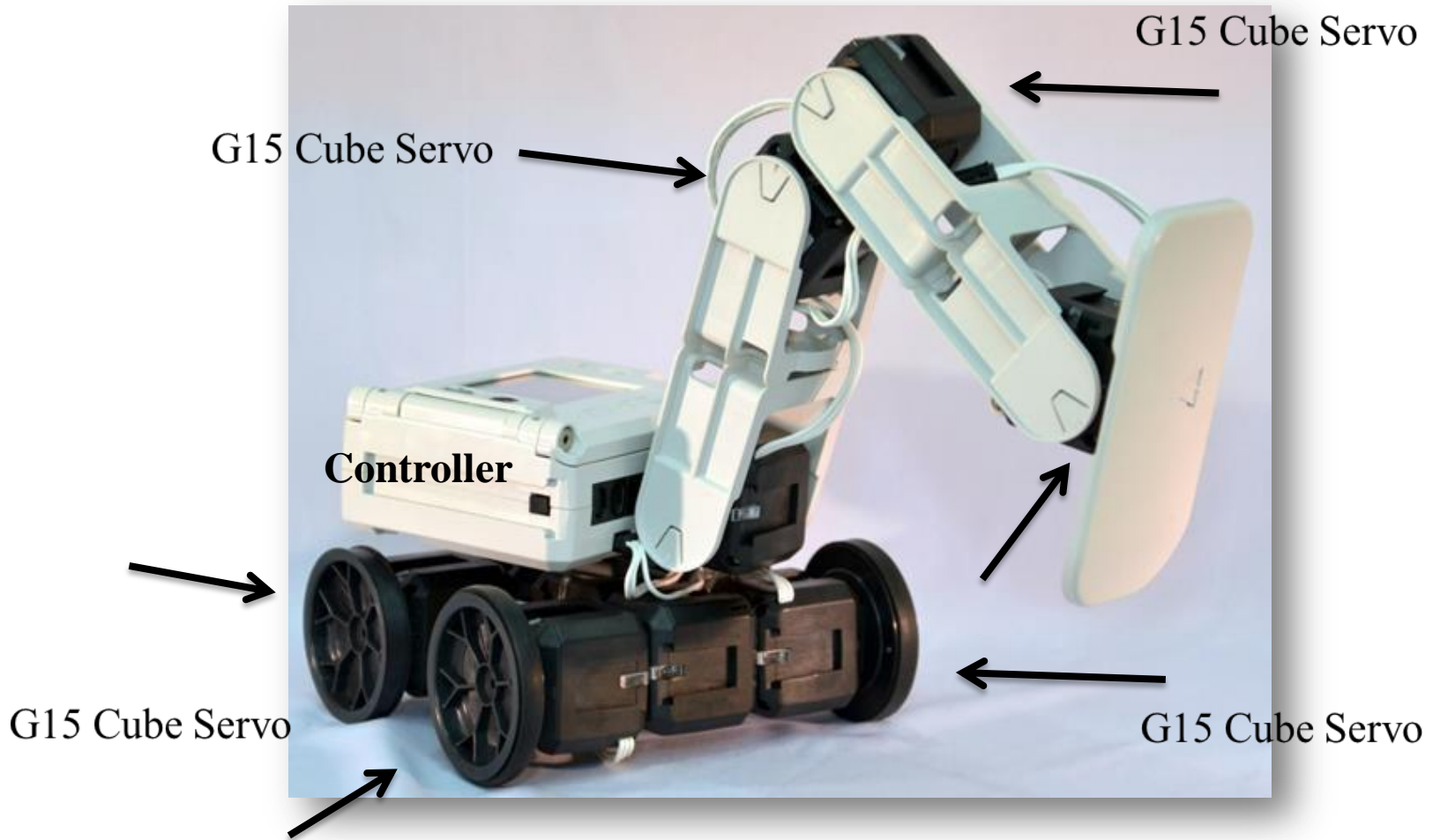
G15 Cube Servo

G15 Cube Servo

Features of G15 Cube Servo :

- Modular type robotic servo

- Cubical outlook and center output shaft to give highest flexibility during robotic model construction

- Five slide-able slots in different orientation

- Screw-less mounting method

- 360^0 endless electrical rotation (1088 steps)

- Daisy chain connection wiring among the G15 cube servos (each G15 cube servo has its own unique ID)

- Serial communication, Half-duplex Asynchronous (max speed up to 500k bps), TTL level, command packet

- Rotation speed or time to reach the desired position can be set

- Able to feedback its angular position, angular speed, current load, temperature and supply voltage

- Auto shutdown if overload, supply voltage error or high temperature is detected (user define the value)

- LED indicator to shows the status of the servo

- Built-in microcontroller built-in to handle all controls

- Origin: Malaysia

6-legged spider pattern

G15 Cube Servo

G15 Cube Servo

G15 Cube Servo

Controller

G15 Cube Servo

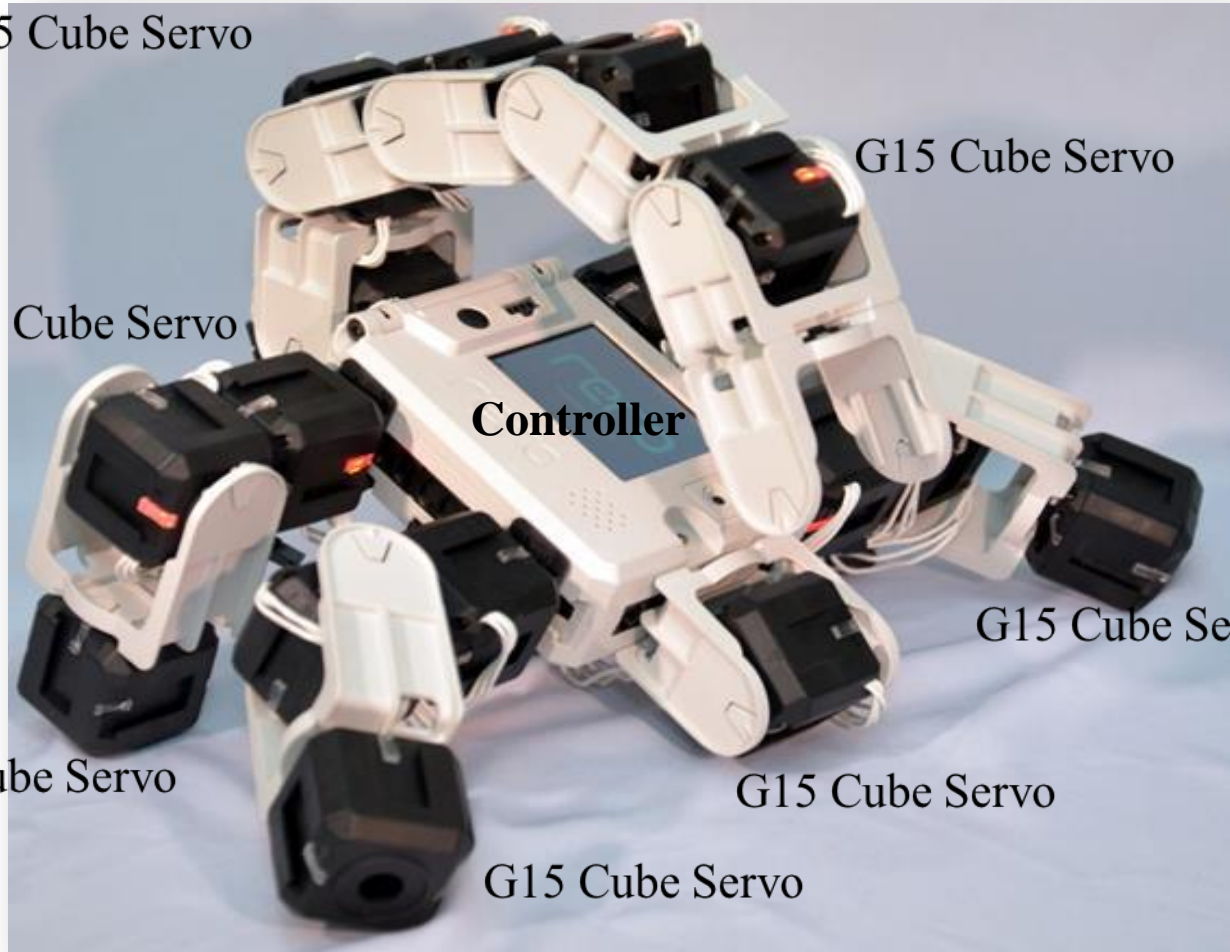# Excavator pattern

G15 Cube Servo

G15 Cube Servo

Controller

G15 Cube Servo

G15 Cube Servo

Scorpion pattern

Humanoid

Alien robot J

4.0: Controller and Sensors are used by Robot

Sensors

| Photoelectric / Line Sensor | Optical / Infrared Sensor | Ultrasonic Sensor | Accelerometer / Gyro / IMU |

Sensors

Laser Range Finder

Rotary Encoder

GPS / Compass

Proximity Sensor

Temperature / Humidity Sensor

Gas Sensor

Others

Image Sensor

- **Main Hardware list:**
- **G15 cube servo, only 1 at a time.**
- **Arduino Uno**
- **Cytron G15 Sheild**
- **LCD keypad sheild**
- **Power Supply or any battery range from 7V to 12V**
- **USB B type cable use to program the Arduino Uno**

- **Main Software list:**

- Arduino IDE

- **Methodologies**

- **PART 1: Hardware Setup**

- 1. Prepare the hardware as figure below.

- 2. Make sure the G15 shield is using internal power and the control connectors are set to D3 and D2.

3.0 Stack all shields on Arduino Uno as shown figure below and connect the power supply and USB B type cable to Arduino Uno and to computer
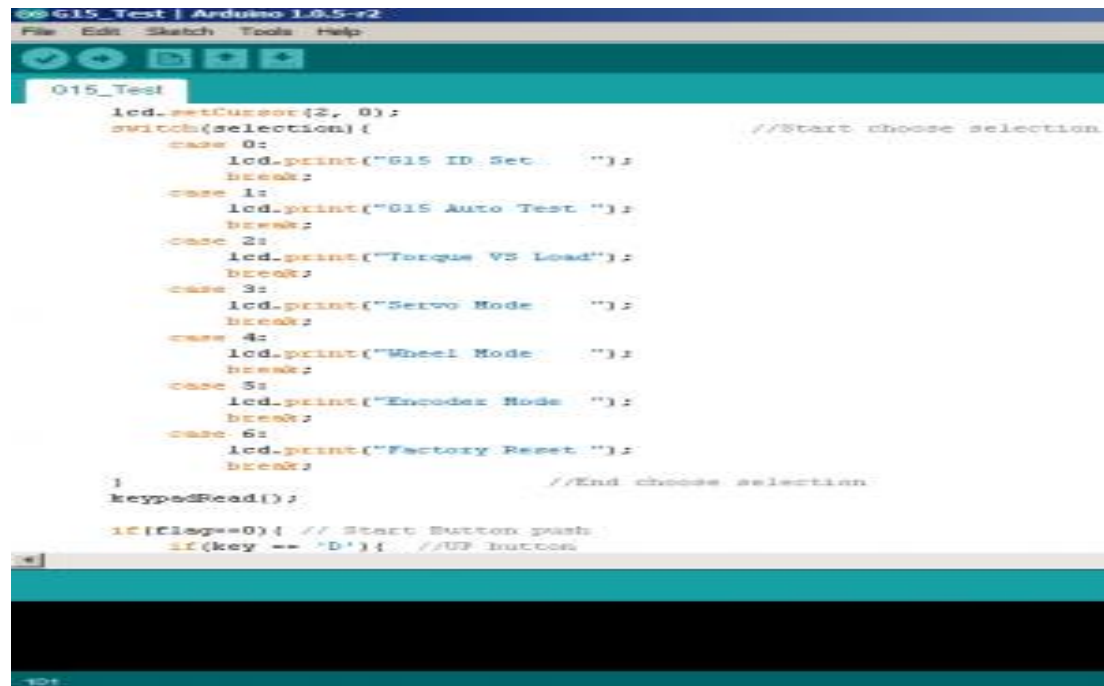
4. After load the example program, make sure to disconnect the USB B type cable and power supply to reset the G15. It seems that after loading program, sometimes the shield or the cube servo stop responding. Reconnect the power and it is ready to control your G15.
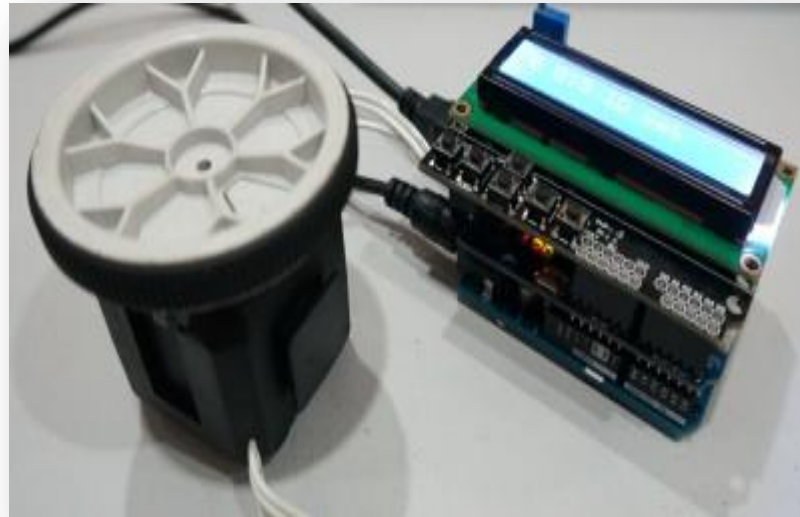
Set up the Arduino IDE

- Download full code for testing your cube servo. Here is the file, G15_Test. This program has 7 selections to test G15 cube servo. Compile this program and burn it into your Arduino Uno by pressing the upload button in the Arduino IDE.

Test the Cube Servo
Main Menu:

* Button indicator: "UP" = Selection Up , "DOWN" = Selection Down

- **Selection 1, G15 Auto Test:**
- Button indicator:
- "SELECT" = Enter selection
- This selection is to test whether G15 cube servo is response or not. When you press "SELECT" button in this selection, G15 cube servo will automatically enter servo mode by rotating to 0 degree and rotating back to 360 degree. It will further enter wheel mode by rotating the motor to full speed and back to low speed.
- **Selection 2, Torque VS Load:**
- Button indicator:
- "SELECT" = Enter selection/Exit selection , "UP" = Increase Torque , "DOWN" = Decrease Torque
- This selection is to demonstrate cube servo torque and its load reading.
- **Selection 3, Servo Mode:**
- Button indicator:
- "SELECT" = Enter selection/Exit selection , "UP" = Increase CW limit , "DOWN" = Decrease CCW limit ,
- "RIGHT" = Increase Servo Position , "DOWN" = Decrease Servo Position
- This selection is to demonstrate cube servo in its Servo Mode. You can set up the servo motor angle limit and observe that G15 servo motor can only operate in its angle limit. If anything goes wrong, just press "RESET" button.

- **Selection 4, Wheel Mode:**
- Button indicator:
- "SELECT" = Enter selection/Exit selection , "UP" = Increase motor speed , "DOWN" = Decrease motor speed ,
- This selection is to demonstrate cube servo in its wheel mode. You can play with the cube servo speed in this selection.
- **Selection 5, Encoder Mode:**
- Button indicator:
- "SELECT" = Enter selection/Exit selection , "UP" = Increase Full Rotation Movement, "DOWN" = Decrease Full Rotation Movement ,
- "RIGHT" = Increase Small Rotation Movement , "DOWN" = Decrease Small Rotation movement
- This selection is to demonstrate G15 cube servo act as wheel with encoder feedback. Set up the full rotation , how much times it will take to make 360 degree ± 10 degree turn and how it will make small rotation which is less than 360 degree represent by 1087 scale.
-
- **Selection 6, Factory Reset:**
- Button indicator:
- "SELECT" = Enter selection, "RESET" = Exit Selection
- Once you push the "SELECT" button, the program will enter the factory reset and reset the cube servo to its factory condition. After push the "RESET" button, you will see the ID of the cube servo reset to 1.

- **Selection 0, G15 ID Set:**

- Button indicator:

- "SELECT" = Enter selection/Set Up new ID , "UP" = Increase ID to be set, "DOWN" = Decrease ID to be set ,

- "RIGHT" = Exit selection

- This selection is to set up new ID and see the current ID of the cube servo connected. By pressing the "SELECT" button, you will set the new ID for the cube servo

Web links, YouTube videos

- https://www.youtube.com/watch?v=OyM2NQMwxoY - action=sharehttps://www.youtube.com/watch?v=G4cXHsghYWw

4. Costing calculation

No.	Descriptions	$USA/ PCS
1	Material cost	$200
2	Tooling cost	$100
3	Process Cost	$100
4	Total	$400

THANK YOU