Hexapod Walking Robot

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Problem Statement

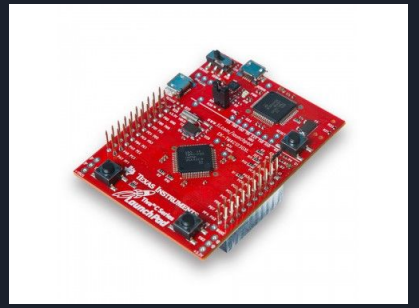
- Maintaining stability and center of gravity while walking forward, backward, and turning can be more challenging for a programmed machine than a human.
- Develop a hexapod-like robot able to move via user control while maintaining balance and stability.

Overview

- Robot design with 6 legs, joints, and frame.
- Wireless control system via web app.
- Programmed to move forward, backward, left and right via microcontroller w/ servo control.
- Designed to mechanically balance itself during movement and, to an extent, readjust from failure.

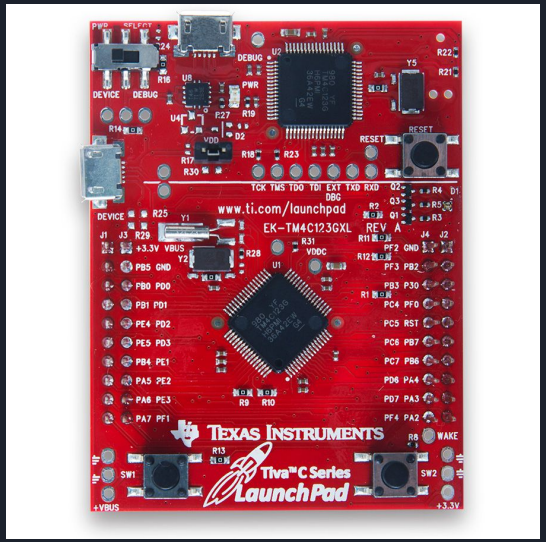
Parts List

1. 12x Servos
2. 1x Tiva-C Microcontroller
3. 1x NodeMCU WiFi controller
4. Laser-Cut Acrylic Framing (Legs, Joints, and Base)
5. PCBs w/ M2 Standoffs
6. 1x Switch
7. 4-40 Machine Nuts and Bolts
8. Smartphone or PC
9. Googly Eyes



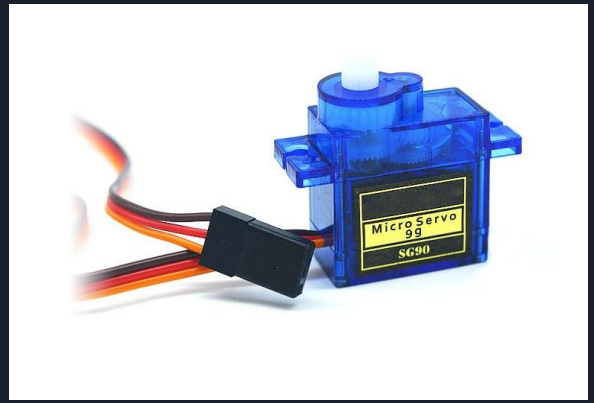
TM4C123GH6PM

- Previously called Tiva-C
- 80 MHz ARM Cortex-M4F chipset
- 35 available external GPIO pins
- 16 independent PWM outputs
- 8 UART Channels
- C99 Standard of C Programming Language
- Allows a 5 Volt input on the VBUS Pin



SG90 Servos

- 14.7 gram Micro-servo
- Rated for 4.8-6 Volts
- 120° range of motion
- Plastic gearing
- 55 Hz PWM pulse train

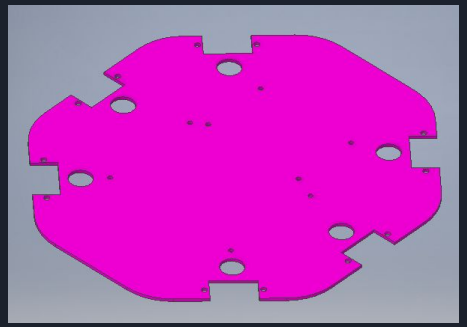


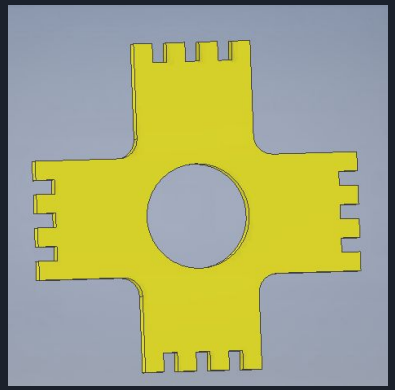
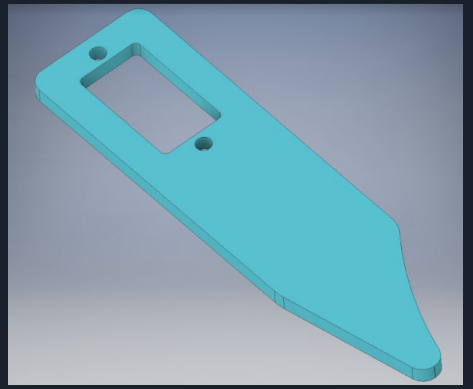
NodeMCU

- Microprocessor with ESP8266MOD Wifi Module
- 802.11 b/g/n Wireless protocol
- Has GPIO pins and supports UART
- Broadcasts own network
- Delivers web pages
- Programmed in modified version of C++

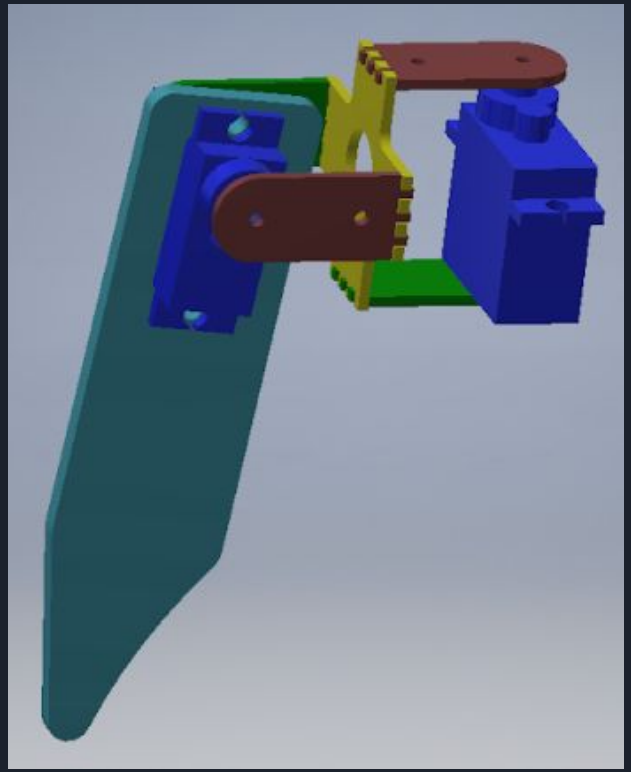
The Body

- Laser-cut framing; legs and joints connected to multiple servo motors for control.
- 6-leg design keeps center of gravity towards the center of the frame.
- PCB w/ microcontroller and power circuit mounted to frame.
- Pointed/rounded legs for stability and readjustment.



The Body (Cont.)



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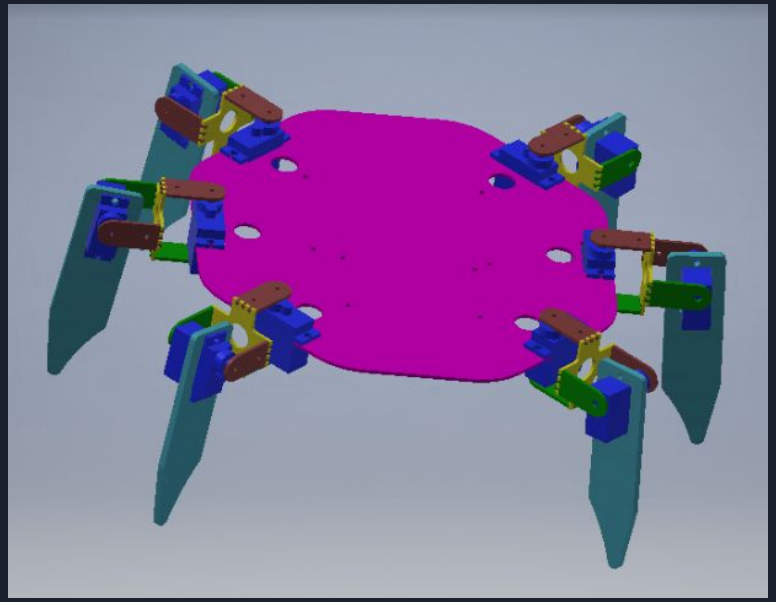
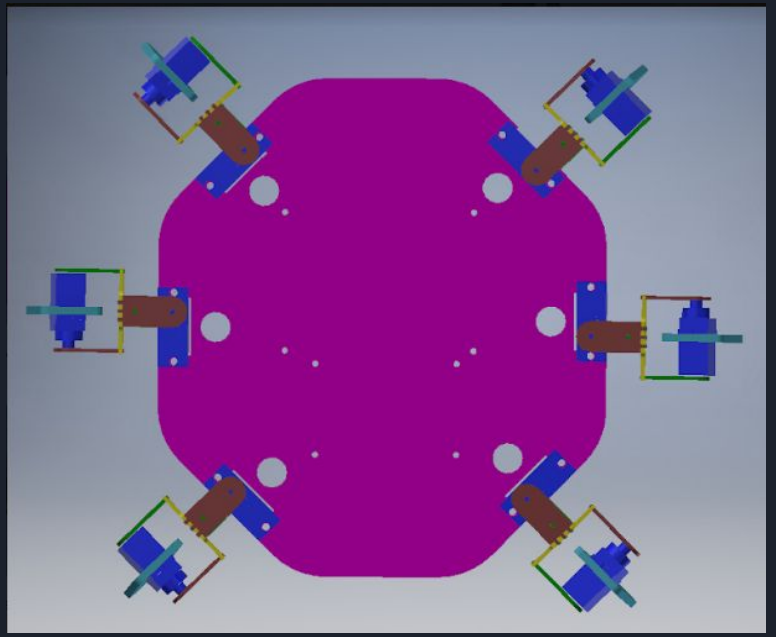
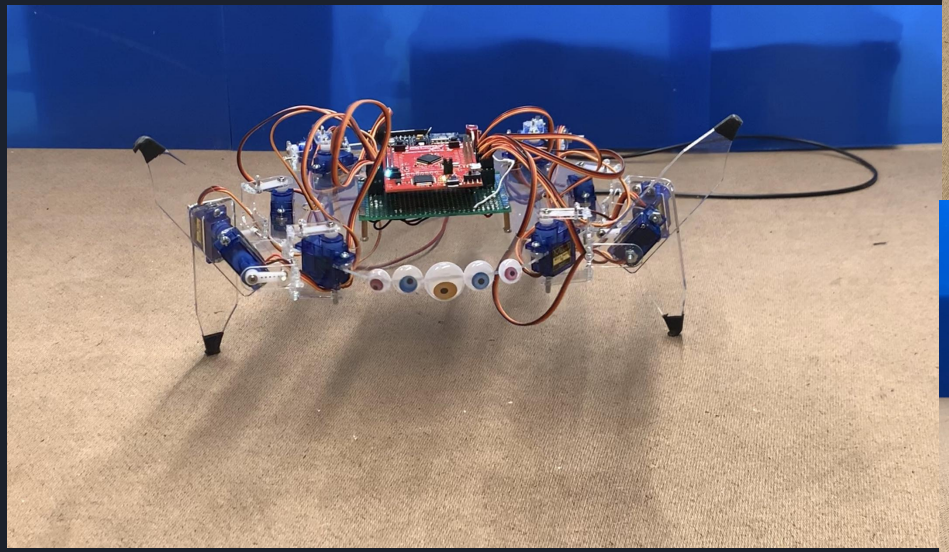
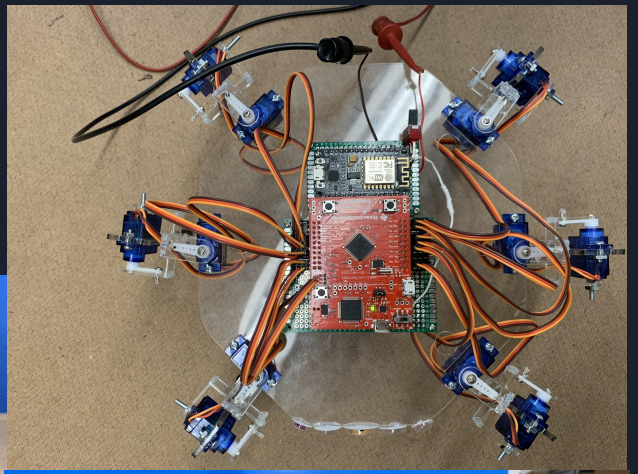
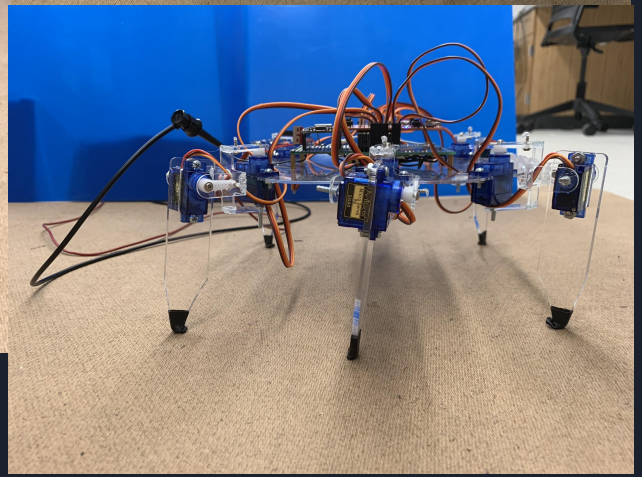




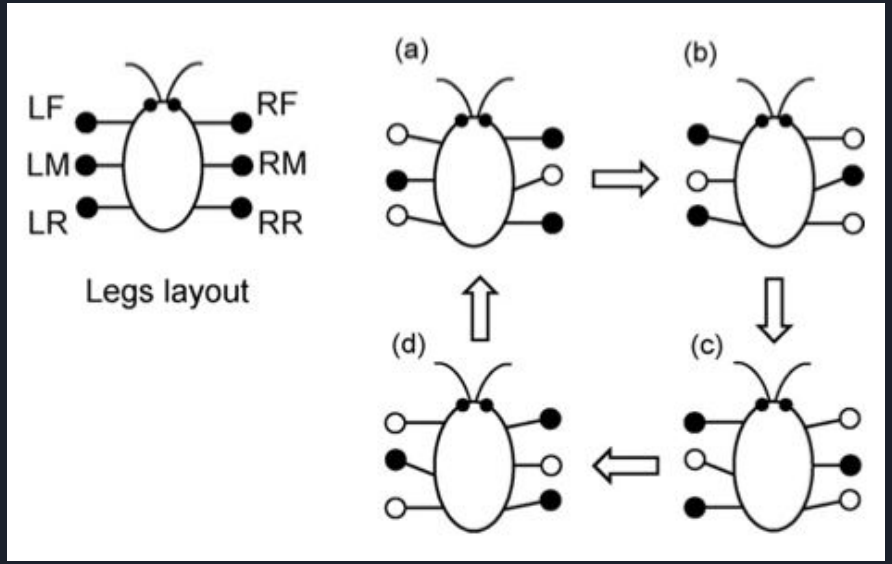
The Body (Cont.)



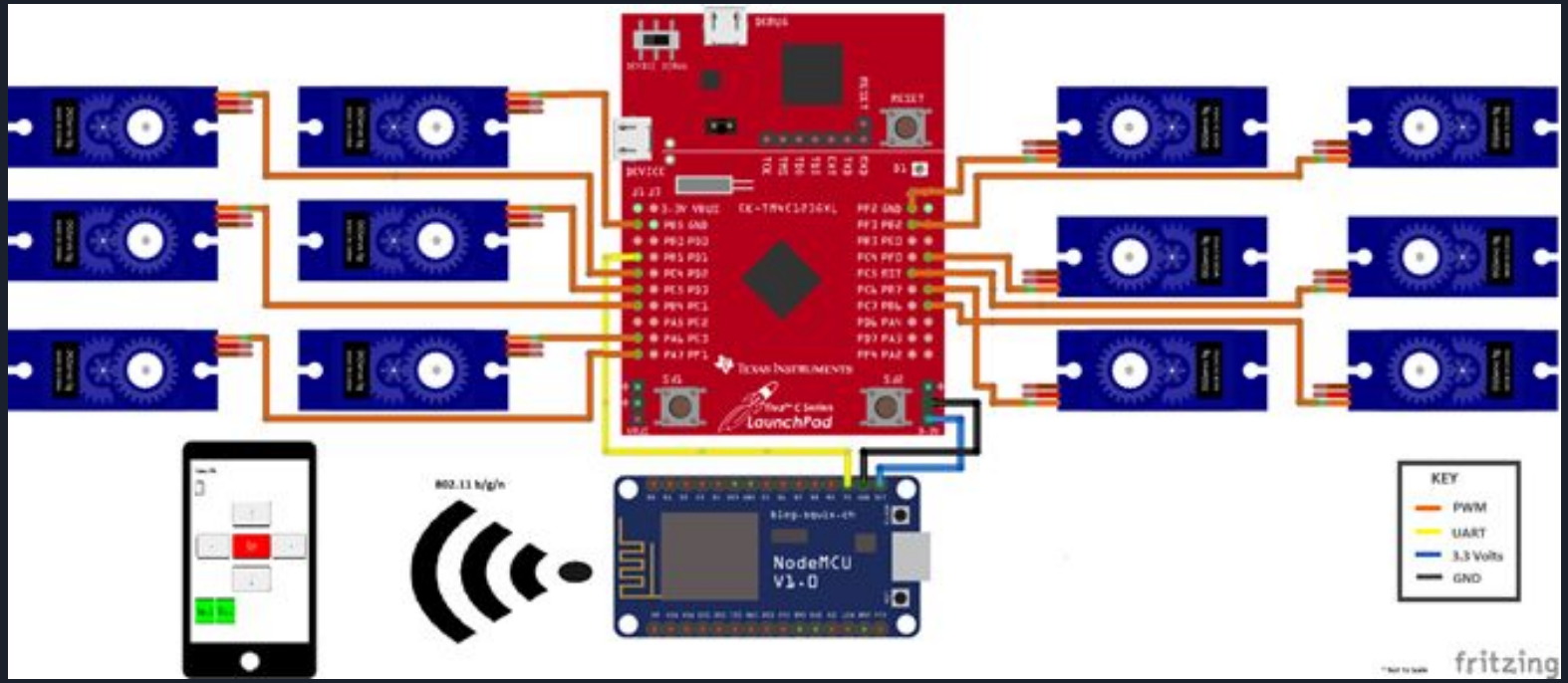




Tripod Gait

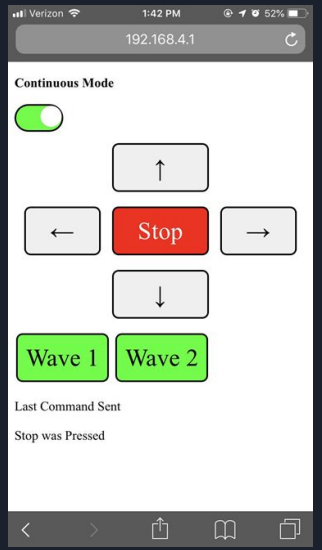


Circuit


LaunchPad
802.11 b/g/n
NodeMCU
V1.0
KEY
PWM
UART
3.3 Volts
GND
fritzing

Web App Controller

- Developed to interact w/ WiFi module and microcontroller.
- Set of commands tells controller which servos to drive to move a certain direction.
- Operable via web address on any browser on PCs or smartphones.
- Written in HTML and uses CSS and AJAX

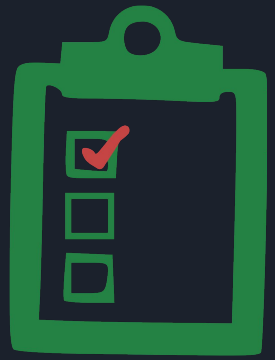


Cost Analysis

Component/ Material	*Quantity*	*Vendor*	*Cost ($)*
Miuzei SG90 Servo Motors	12 (+ Extras)	Amazon.com	34.58
TM4C123GH6PM Microcontroller	1	Mouser	13.45
Node-MCU V1 Wifi Module	1	Amazon.com	8.39
4-40 Machine Bolts and Nuts	30 each (+ Extras)	Raby's Ace	12.44
6 x 8 cm Prototyping PCB	1 (+ Extras)	Amazon.com	5.99
4 x 6 cm Prototyping PCB	1(+ Extras)	Amazon.com	6.99
M2 Standoff Kit	1	Amazon.com	8.99
1/16 in Thick 16x24 in Acrylic Sheet	1	ePlastics.com	8.49
1/8 in Thick 16x24 in Acrylic Sheet	1	ePlastics.com	21.69
Two-Part Quick Setting Epoxy	1	Walmart	5.35
3/8 in Heat Shrink Tubing	1	Jameco	1.75
Colored Googly Eyes	1	Dollar Tree	1.00
Total Cost			*129.11*

Work Process

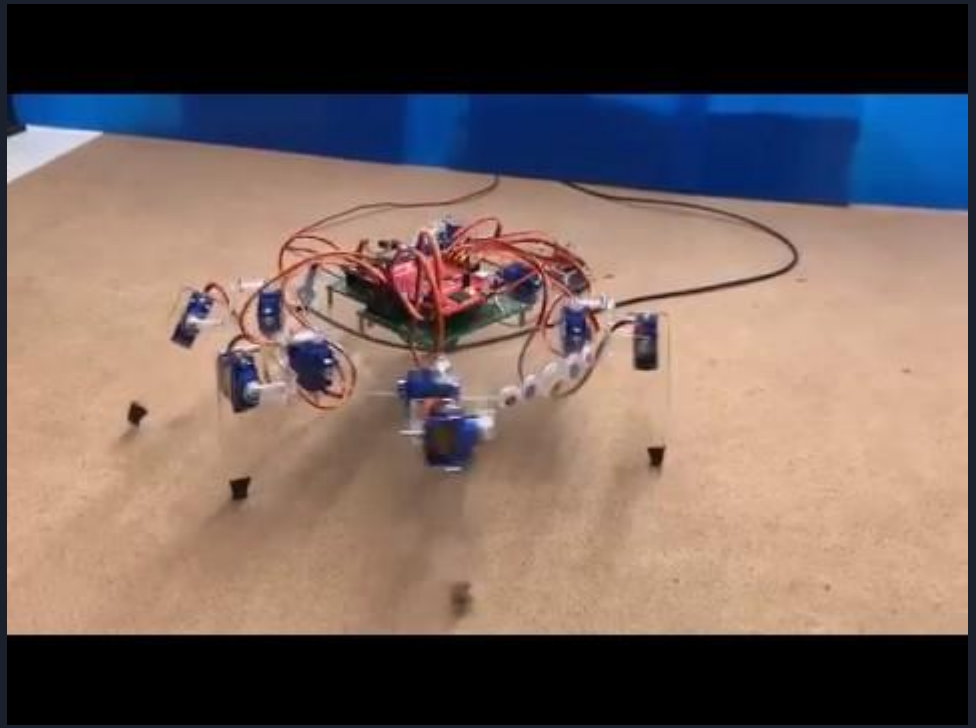
1. Designed frame parts w/ Autodesk Inventor software
2. Developed control code for microcontroller to interact with servos
3. Developed web program for remote control of microcontroller
4. Laser-cut acrylic frame components
5. Build phase: Built frame and compiled programs
6. Test phase: Checked build quality and tested program functions
7. Refined programs and component designs; repeated build and test phases as necessary



```
string sInput;
int iLength, iN;
double dblTemp;
bool again = true;

while (again) {
    iN = -1;
    again = false;
    getline(cin, sInput);
    system("cls");
    stringstream(sInput) >> dblTemp;
    iLength = sInput.length();
    if (iLength < 4) {
        again = true;
        continue;
    } else if (sInput[iLength - 3] != '.') {
        again = true;
        continue;
    } while (++iN < iLength) {
        if (isdigit(sInput[iN])) {
            continue;
        } else if (iN == (iLength - 3)) {
```

Video



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References

References

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Any Questions?

Thank you for your attention!