

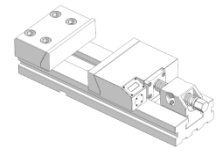
## Specification of the system

### 1. Framework conditions of the solution

Number intelligence gripping system using the hydraulic technology, radio technology, embedded application technology, mechanical engineering, finite element analysis technology, IT technology, make the gripping process known, measurable, visible, controllable, realize the closed loop control of digital machinery manufacturing, reduce parts due to improper gripping, no, uncontrollable factors caused by poor quality.

### 2. The goal of the solution

Digital intelligence gripping system is mainly used to improve the gripping accuracy, improve the production efficiency and production quality, The system integrates high-precision sensor and intelligent control module, Make force deformation measurement on product trial production before processing clip, To obtain the force-bearing deformation curve of the part, Find the maximum grip force when the part force does not exceed the tolerance, Provide specific holding parameter reference for mass production; During the processing process, The system can rough process in real time, rough finishing, Finishing and adjustment of the grip strength, At the same time in the processing process to achieve the whole holding force monitoring, Ensure that the workpiece is stable and not damaged during clamping, Minimize the



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deformation and damage of the workpiece. Through wireless communication and torque motor, accurate clamping, improve the clamping efficiency, reduce the unstable quality of mass production product due to uneven experience and hand feel, and make the clamping operation more efficient, accurate and more adapt to the changing processing process. After the processing, the part results upload to the system database, accumulate materials and experience, provide valuable reference for subsequent production, and clearing the way for the product from experimental prototype to mass production.

### 3. technical proposal

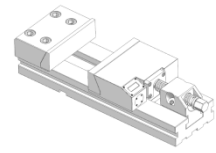
#### 1. Composition and function description of the digital intelligence gripping system

The system is composed of server, digital vice, displacement sensor, inclination sensor and torque motor, as shown in Figure 1.



Figure 1. Composition of the intelligent clamp system

The server mainly collects information about part



**drawings, materials,** 3 D model, part holding mode, process step content, curve of part holding force and deformation, data changes in the process of part processing, makes clamping rules, adjusts the parameters of the vice, and provides users with big data reference.

**Digital vice,** through the hydraulic clamp of the parts, and detect the clamp force of the parts, the data display on the vice LCD screen, through radio technology, the data to the server.

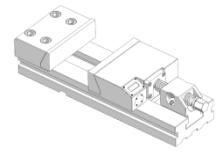
**Displacement sensor,** mainly used to detect the value of the part deformation displacement, while using the SPC protocol to transmit the data to the server.

**The inclination sensor is mainly used to detect the distortion value of** the part in the three directions of X, Y and Z, and to transmit the angle data to the server through ZigBee communication.

**Torque motor,** mainly by rotating the vice screw, to achieve the vice clamp.

## 2. The working implementation process of the digital intelligence holding system

Detection process of parts force deformation curve: through digital vice clamp parts (test piece, first piece, engineering sample), and the displacement sensor, inclination sensor in the parts of the measurement, through the server real-time acquisition parts force size, parts warp



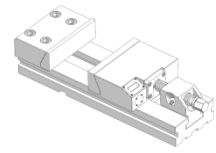
Angle, parts size change, and generate clamp force size, Angle change, size change curve, provide clamping data guidance for automatic mass production, and the database provides historical data reference for processing.

Parts of automatic clamp implementation process: the number of wisdom clamp system can be connected to the production line or CNC equipment, production line or CNC equipment through the communication process or step information sent to the server, by the server to the torque motor command, drive the moment motor drive clamp screw clamp, the digital vice feedback clamp force size, further adjust the action of the torque motor, until the target clamp force size. During the processing process, it constantly monitors the change of the clamp force, judges the state of the parts, and judges whether the clamp force should be adjusted according to the server rules for different processes or steps, so as to realize the automatic clamping and control process of the parts in production.

### **3. Technology of the digital intelligence gripping system**

In the number of intelligence gripping system server, through the MySQL technology set up parts database, through the data in the database, the operator before processing according to the processed parts materials and structure, screening approximate clamp scheme and parameters, reduce the artificial judgment of clamp force size and long

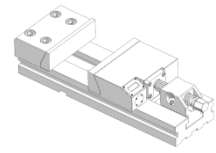
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test, reduce the overall processing time, speed up the production efficiency, reduce the different people of processing clamp force judgment and influence. Improve the mass production of parts and quality stability, reduce the scrap rate of parts processing. (Improve the scrap rate)

In the processing process of the parts, when the volume of the parts is reduced with the increase of the processing progress, the initial grip force is no longer suitable for the changing parts. Through data analysis and server rules, the digital grip system changes the holding of the product grip force in real time, so that the parts are clamped by the most appropriate grip force. It solves the problem of not controlling the holding force in the machining process of the parts. (Solve the difficult regulation)

The PD proportional algorithm, the proportional differential control algorithm, is a simplified form of PD control algorithm. By removing the ordinary calculation process (PD algorithm) integral algorithm process, make the clamping control process is simple, make the vice complete clamp target faster, in the process of clamping, the system avoids the pneumatic clamture, electric fixture due to the fluctuation of gas source and power grid griping force unstable phenomenon, through the vice feedback clamping force size, torque motor adjust the clamping force, form a closed loop control, makes the clamping



force more accurate. (Solve the clamp instability)

#### 4. Security index

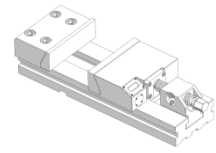
The vice: the material uses 0Cr17Ni7Al high rigid alloy steel, against the tremor generated by the operation, and increase the shock absorption by the internal disc spring. With the hydraulic protection device and the overload protection function, to prevent the personnel injury caused by the hydraulic oil leakage and the safety accidents caused by the equipment damage after the overload use. The equipment can work stably in the environment of  $-10^{\circ} \sim 40^{\circ}$ .

LCD screen: sapphire material screen, and Mohs hardness of 9, rigid, can resist 2000MPa pressure strength; operating temperature range in  $-30^{\circ} \sim +70^{\circ}$ : can do thinner, further reduce the thickness of the body; higher refractive index, improve the visual experience. With dust and waterproof design, protection grade up to IP54.

Main control circuit board: the power consumption is very low, only need a few milliamps of current, small risk, strong endurance

Diameter: the shell is made of aluminum alloy, which can withstand the compressive strength of not less than 10MPa. It can withstand a free drop test of 1 meter height and function normally. Can work normally in an environment of  $-40^{\circ} \sim 85^{\circ}$ . At the same time, it has the functions of over current protection, over voltage protection and short circuit protection to ensure the electrical safety in various environments.

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Displacement sensor: The shell is made of engineering plastic and can withstand the compressive strength of not less than 10MPa. It can withstand a free drop test of 1 meter height and function normally. It can work continuously for 96 hours in  $-40^{\circ} \sim 85^{\circ}$  environment, without significant performance degradation or material degradation.

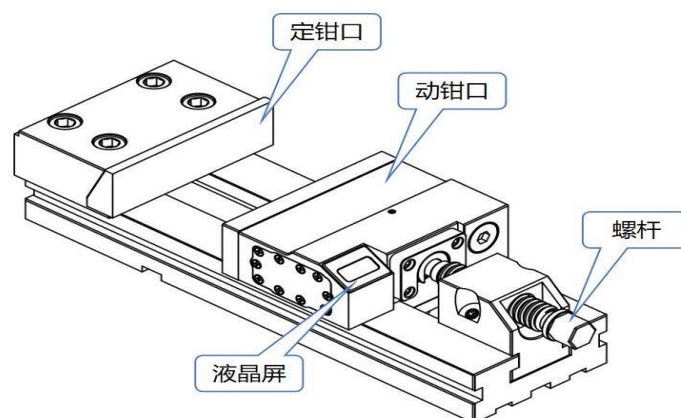
### 5. operation manual

#### 1, the basic parameters of the digital display vice

LCD display, jaw width 120mm, maximum clamping length 200mm, jaw height 40mm, pliers full weight 18 Kg, jaw pressure measurement accuracy 10N, force measurement display accuracy 0.001 (customizable accuracy), maximum clamping force 50 KN, communication mode ZigBee, WiFi, 485 (optional), battery life more than 80 hours.

#### 2, the display visuse instructions

Place the parts against the one side clamp; twist the screw clockwise to move the clamp in the clamp direction and display the measured grip force value on the LCD screen.



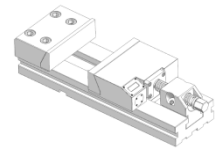


Figure 2

### 3. Basic parameters of the inclination ometer

System power supply: charging power supply: DC5V1A; System operating current of DC5V0.05A; Battery capacity: 5V800mAh; Working environment: temperature 0°C ~40°C relative humidity 85% (25°C) altitude <4000M; Overall dimensions: 60.8mm×50.7mm 37mm; Display specification: 0.96-inch LCD; Safety protection: with overcurrent protection measures; Communication mode: RS232, WIFI, ZigBee (optional); Detection accuracy:  $\pm 0.002$  degrees, Detection speed of 10ms, Display accuracy is 0.001; Range: X, Z  $\pm 180$  degrees, Y  $\pm 90$  degrees; Battery life: 24 hours; Operation mode: key press; Complete machine quality: 1,720 grams; Upper computer: based on windows (optional); Communication mode: 485, 232, WIFI (optional);

### 4. Instructions for using the level instrument function

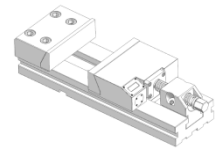
Charging: connect one end of the charging cable to the 5VUSB charger and insert one end into the charging port.



Power on: turn on the equipment switch, 2 seconds after self-test, when there is a value display, X, Y, Z display as 000.000, per unit of degree.

Use method: wipe the placed surface clean, put the level instrument





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on the surface of the measured image, wait for the value to read the corresponding value, can be adsorbed on the surface of the measured object.

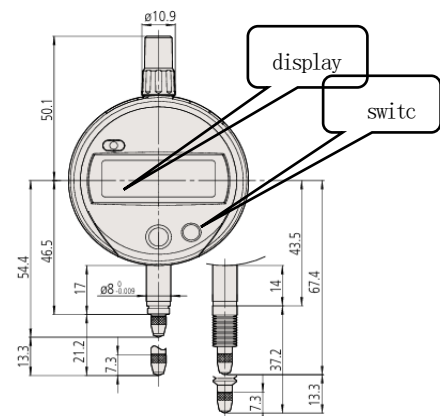
Storage method: Due to the built-in battery, please store the pressure gauge in the fire cabinet, no impact and high temperature use.

Maintenance method: clean the level surface with dust-free cloth before and after each use, wipe it clean with dust-free cloth, and keep it clean and dry. Pressure, side push and impact are strictly prohibited.

### 5. Basic parameters of the displacement sensor

#### 6. Instructions for using the function of the displacement sensor

Power supply: directly replace the appropriate battery; switch: click the switch to switch the equipment; use method: gently press the displacement sensor and the supporting equipment with the pointer and check the value change. Equipment storage: due to the built-in battery, please store the pressure gauge in the fire cabinet, no impact and high temperature use.

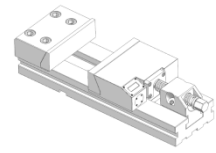


## Vi. Data description of the tools used

### 1. Software tools

Keil is a software kit for embedded development systems widely used

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in programming and debugging of microcontrollers and other embedded devices. It provides an integrated development environment (IDE) that includes code editors, compilers, debuggers, and emulators.

Multisim is a software tool widely used in circuit design and simulation, especially suitable for the analysis and testing of analog, digital and power electronic circuits.

This is the software used to analyze the circuits.

AltiumDesigner Is a software tool widely used in electronic design automation (EDA), mainly used for printed circuit board (PCB) design.

UG (NX) We use it in the design of the digital intelligence clamp system, UG software provides advanced modeling and free-form surface design tools that can create complex geometry and surfaces to meet various design needs. With precise modeling tools and flexible free-form surface design, users can quickly translate design ideas into practical models.

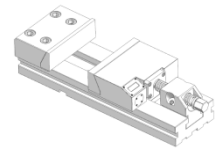
Mastercam We mainly use CAM function to program the product, its tool path generation algorithm is very efficient, can generate high quality tool path.

## 2. Test tools

### 1) [Signal source of the SDG1062X waveform generator](#)

Output frequency: 60 MHz, sampling rate of 150 MSa / s, vertical resolution of 14bit, number of channels of 2, arbitrary wave length of

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16 kpts.

### 2) DP800 series programmable linear DC power supply

Number of channels 3, 8V / 5A | | 30V / 2A-30V / 2A, maximum power 160W, ripple noise <350 uVrms.

### 3) DM3068 Digital multimeter

Accuracy of 6.5, DCV annual accuracy of 0.0035%, the fastest measurement speed of 10 Krdgs / s, Connectivity USB, GPIB, LAN, RS232

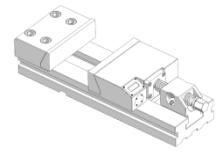
### 4) on the JT-H120 industrial electron microscope

Sensor Sony chip, image size 1 / 2.8, resolution 1920 \* 1080 660 FPS, output interface HDMI, image size 2 UM \* 2 UM, power DC-12V / 1A, display HD HDMI interface display, multiplier 20-150 / 40-300, bracket size 37 \* 26 \* 35cm, working height 10-22 cm, resolution 1920 \* 1080.

### 5) MS05104 digital oscilloscope

Simulated broadband 350 MHz, rise time greater than or equal to the number of 1ns input / output channels, 16 digital channel inputs, 2-channel arbitrary generator output. Real-time sampling, the maximum simulated channel sampling rate is 8 GSa / s (single channel) and 2 GSa / s (full channel). Maximum storage depth of 500.000wfms/s. Hardware real-time waveform recording 450,000 wfms (single channel); peak detection at all time base settings, capture the narrowest 500ps burr display size and type 9 inch multitouch capacitive screen / support gesture operation; display resolution 1024x600.

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## 6) CNC machining center 850e

Three-axis stroke: X / Y / Z axis stroke is 830mm / 530mm / 560mm respectively, suitable for processing larger size workpieces. Spindle speed: the maximum speed can reach 10000rpm, providing high speed cutting capacity and improving processing efficiency. Spindle taper: ISO40 (BT40) standard, easy tool replacement and compatible with a variety of tools. Feed speed: fast feed speed can reach 48m / min (X / Y / Z axis), cutting feed speed range, to meet different processing requirements.