We disassembled a damaged VEX remote controller, whose left joystick falls left. On the surface, there are two joysticks, 12 buttons, one USB port, three other net ports, a power switch, four LEDs and a hole denoted by ‘config’.

Fig.1 The VEX remote controller.

Inside the shell, there are a main PCB and other small PCBs connected by cables together, see Fig.2.

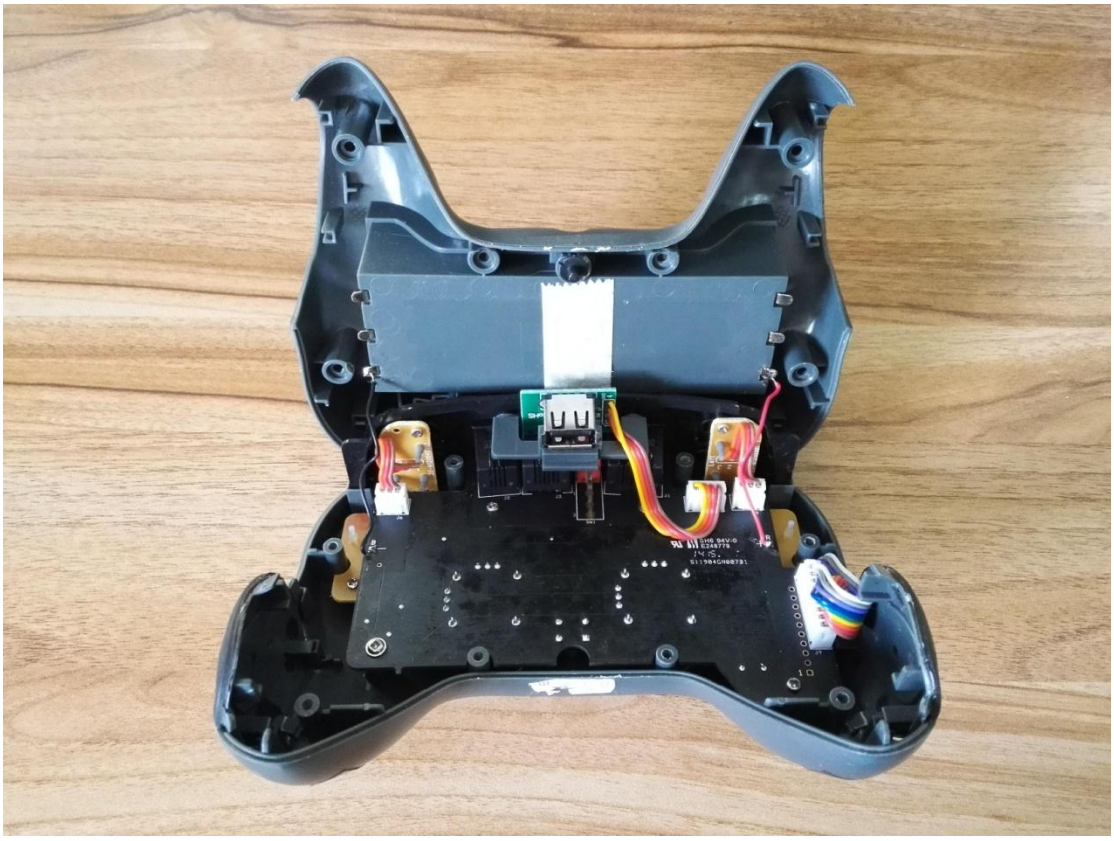

Fig.2 Inside view of the joystick.

The main PCB in shown in Fig.3, where most conspicuous parts are potentiometers ‘R23’ and ‘R24’, see Fig.4. The input shaft can swing up, down, left and right, so the joystick’s movement along two directions can be measured by resistance values.

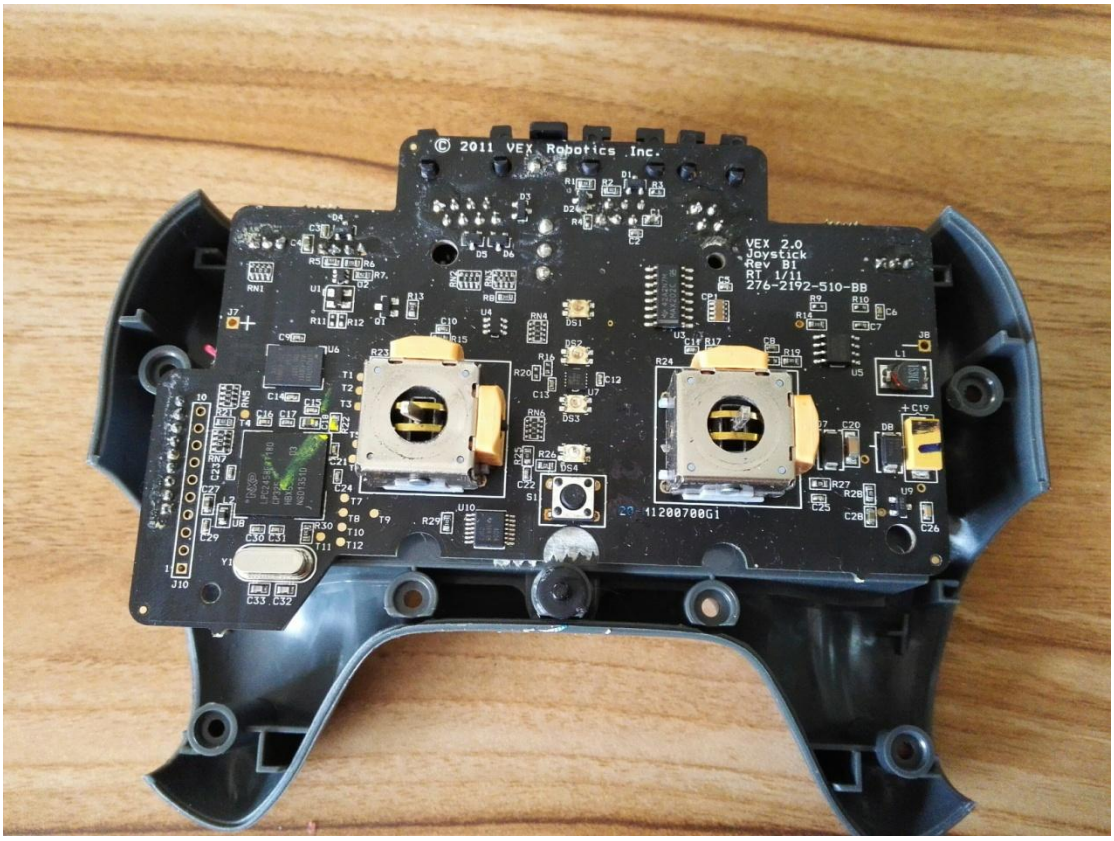

Fig.3 The main PCB.

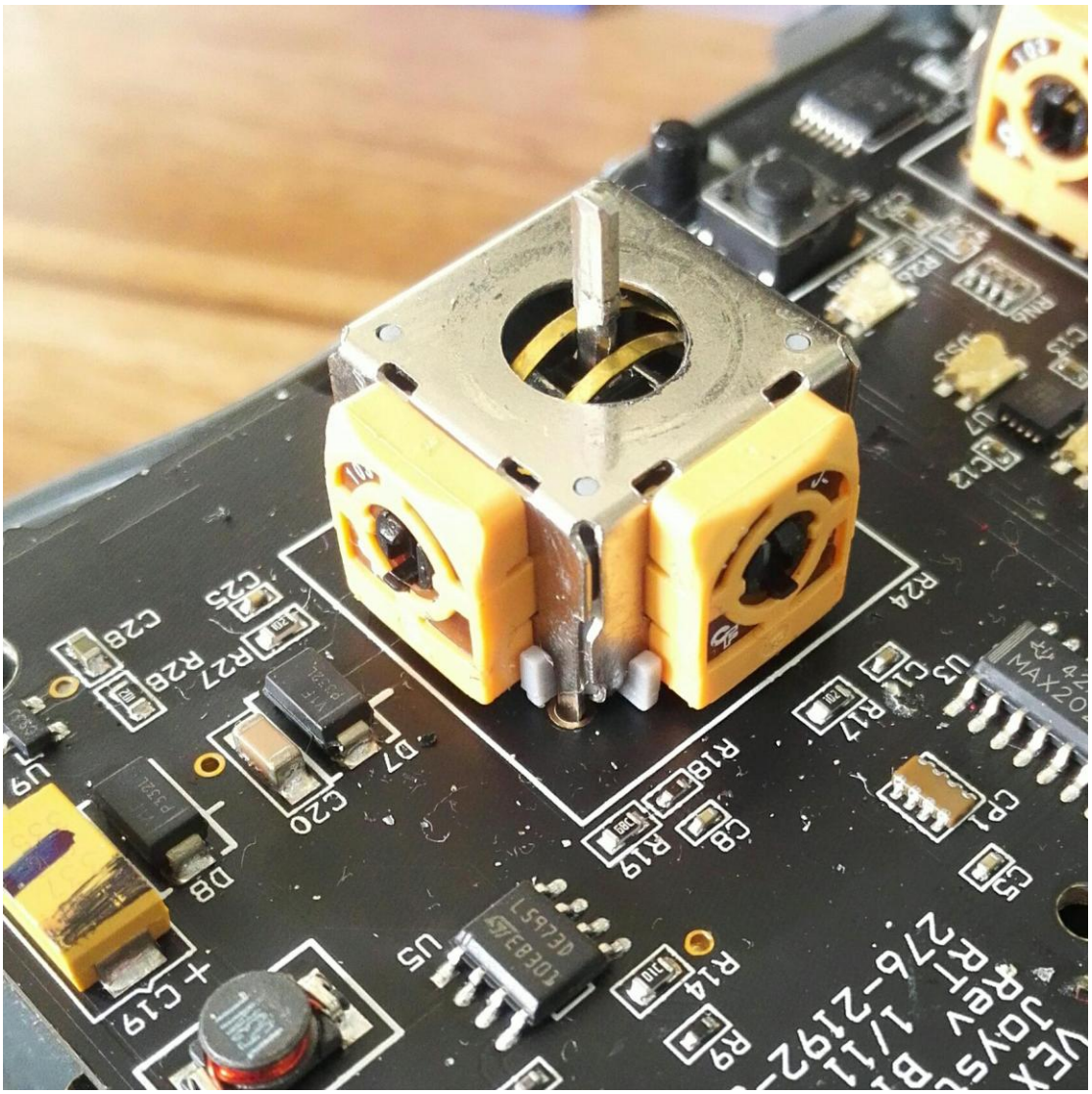

Fig.4 The potentiometer R24 connected to joystick.

Major IC chips are listed in Table.1.

Table.1 Major IC chips

Symbol	Model	Description
U8	NXP LPC2458FET180	A microcontroller around a 16-bit/32-bit Arm7TDMI-S™ CPU core designed by NXP® Semiconductors. It's responsible to react events of button, joystick, net ports etc.It's the brain of this equipment.
U6	CY62157EV30LL-45BVX1	A high performance CMOS static RAM designed by Cypress semiconductor. It provides memories for all calculation tasks.

U7	263 7660 3TZI	A CMOS voltage converter designed by Intersil. It's responsible to supply power of suitable voltage to some parts in the circuit.
U3	**TI 42A2N7M** **MAX202C**	**A 5-V dual RS-232 line driver and receiver designed by Texas Instruments. The data either received from or sent to RS-232 bus will be converted here, i.e. it acts as the interface between microcontroller and RS-232 bus.**
U5	L5973D EB301	A step down monolithic power switching regulator designed by STMicroelectronics.

There are four luminous diodes on the PCB, denoted by 'DS1' to 'DS4', correspond to indicators 'joystick', 'robot', 'vexnet' and 'game' on frontal panel. The switch 'S1' corresponds to a hole 'config' on the frontal panel. This function can be triggered by pressing this switch using a pin.

Other individual PCBs act as interface to buttons. Taking buttons No.5 as an example, see Fig.5. The rubber part pops the button back when it's released.

Fig.5 Parts of button No.5.

The interface to buttons No.7 and 8 are similar with button No.5, this PCB are not excreted, see Fig.6. Note, there are four transparent plastic parts, they act as light aisles between the LEDs on the main board and indicators on the panel.

Fig.6 The backside of the frontal panel.

The PCB as the interface to USB port is very simple, only four cables. One for power, one for ground, another two for signals ‘DM’ and ‘DP’. The shell of the port is connected to ground.

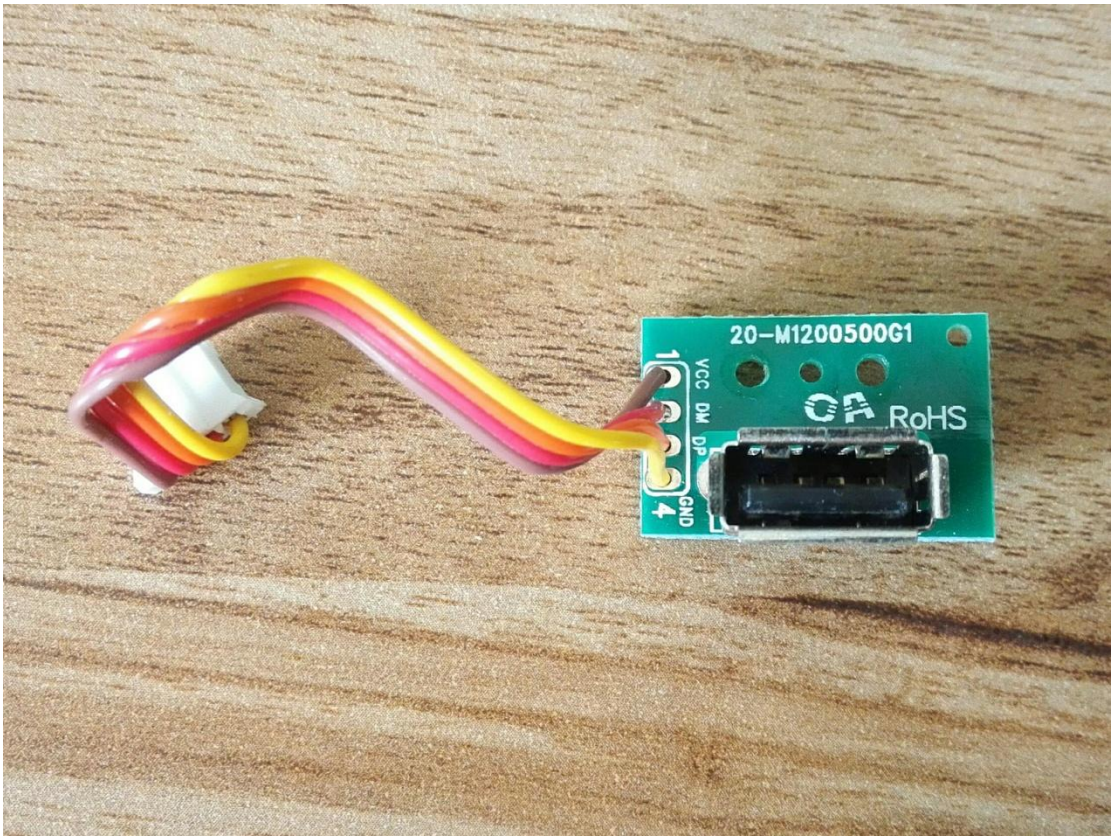

Fig.7 USB port.

The function of circuits can be summarized as follows. The microcontroller samples the events from all buttons and two joysticks, then send corresponding commands to robot via wireless net. It also can receive data from robot via the net.

Besides, the damaged joystick was repaired. We just made the bended shaft of potentiometer R23 straight again, and now it works well.