

Figure S1. The control flowchart of the input system.

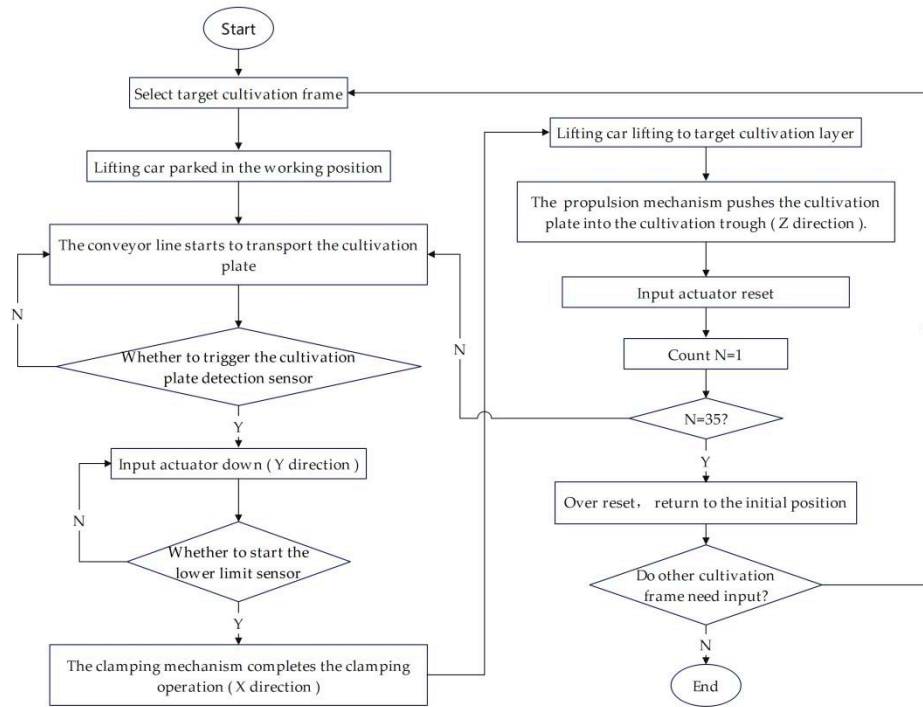


Figure S2. The control flowchart of the output system.

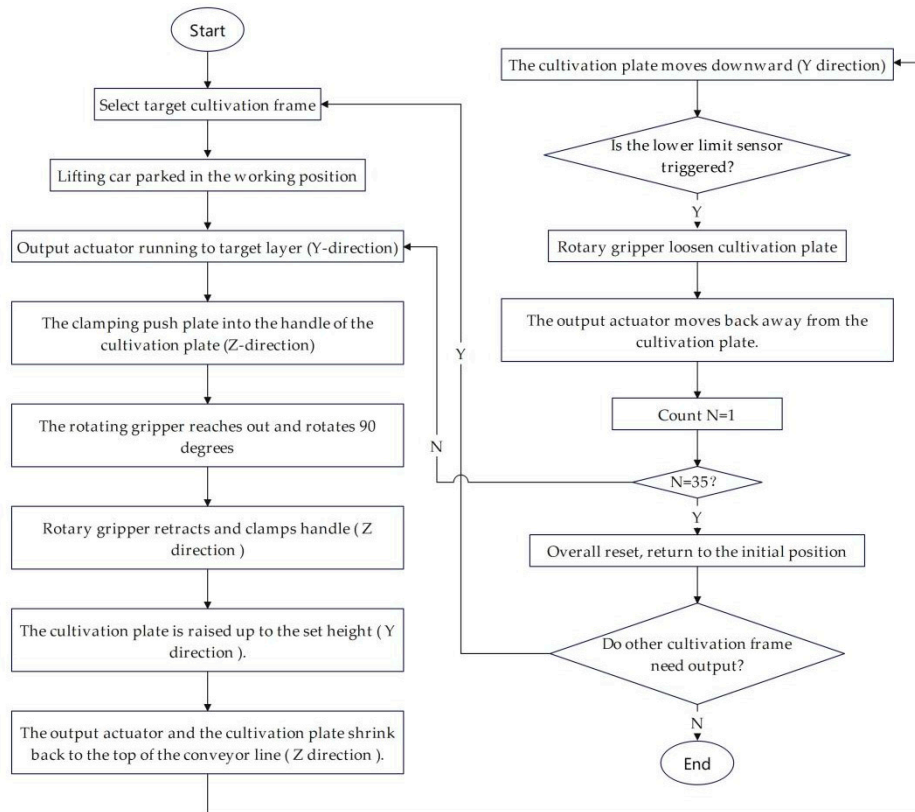


Figure S3. The circuit diagram of the input system.

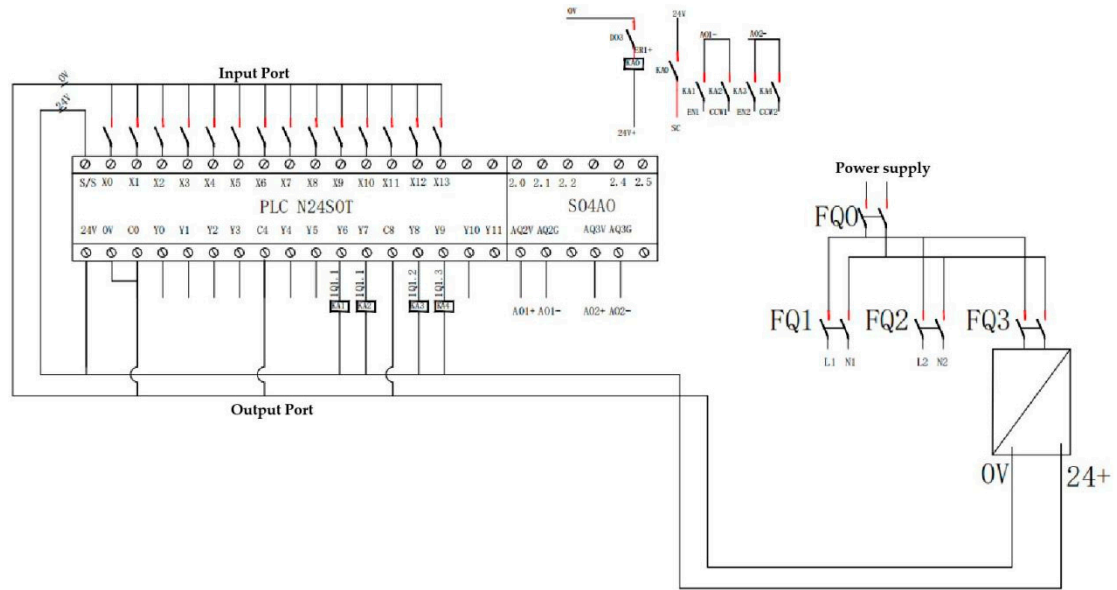


Figure S4. The circuit diagram of the output system.

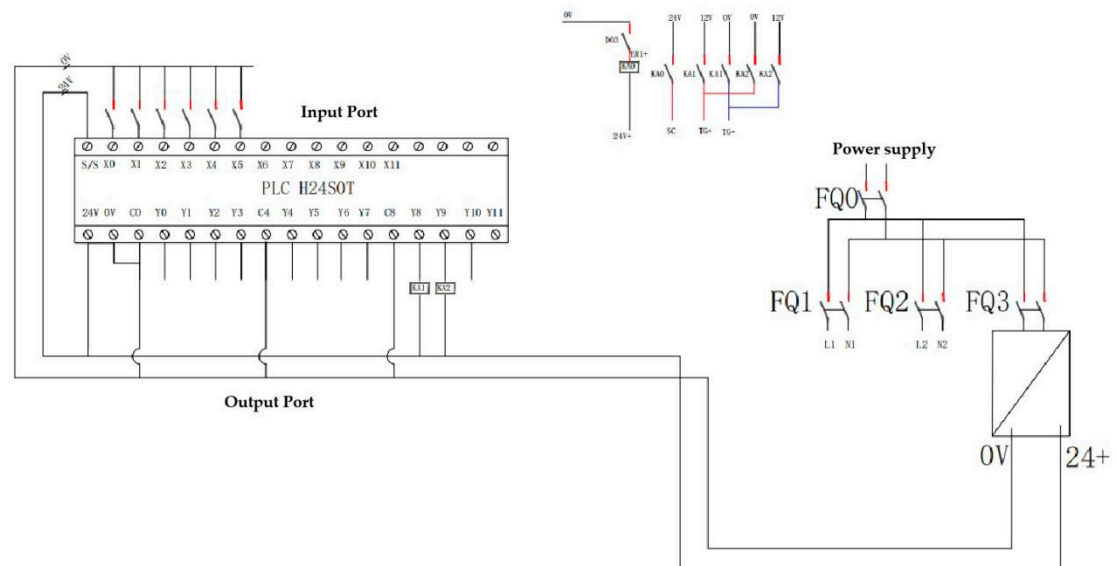


Table S1. Electrical component parameter table

Name	Number	Model	Parameters	Manufacturer
PLC	2	N24S0T	16 switch inputs, 12 switch outputs, 6 high pulse inputs, 4 sets of analog inputs and outputs, and RS232+RS485 communication ports.	Xiamen Haiwei Technology Co., Ltd., Xiamen, China
Private server motor	2	SD50-G751	Rated voltage AC220V, output current 6A.	Xiamen Haiwei Technology Co., Ltd., Xiamen, China

driver				
Propulsion motor	2	57BL77S10230 TF9	Rated voltage DC24V, rated speed 300rpm, rated torque 0.32N. m, power 100w.	Beijing Times Chaoqun Electrical Technology Co., Ltd., Beijing, China
Propulsion motor driver	2	ZM-6506	The maximum output current is 5A, and the applicable voltage range is DC12-60V.	Beijing Times Chaoqun Electrical Technology Co., Ltd., Beijing, China
Clamping motor	1	57HS09	Step angle 1.8 °, torque 1.2N. m	Wenzhou Pufeide Electric Co., Ltd., Wenzhou, China
Clamping motor driver	1	DM542	Current 4.2A, applicable voltage range DC9-24V.	Wenzhou Pufeide Electric Co., Ltd., Wenzhou, China
Proximity switch	14	I2B1204NO	Thread diameter M12, PNP normally open, working voltage DC10-30V, maximum detection distance 15mm	Luoshida Sensor (Dongguan) Co., Ltd., Dongguan, China
linear actuator	1	IP60	DC12V, stroke 10mm, thrust 40N	Zhejiang Haoran Technology Co., Ltd., Leqing, China