



Optical Tracking System For Target Following Camera

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Target Following Camera



Keeps the target in frame

Can be used to track:
Performer on stage;
Specific player of outdoor sports game;
...

Goals of the Project

- Design a positioning system for a target following camera
- Build a prototype

Optical Tracking System

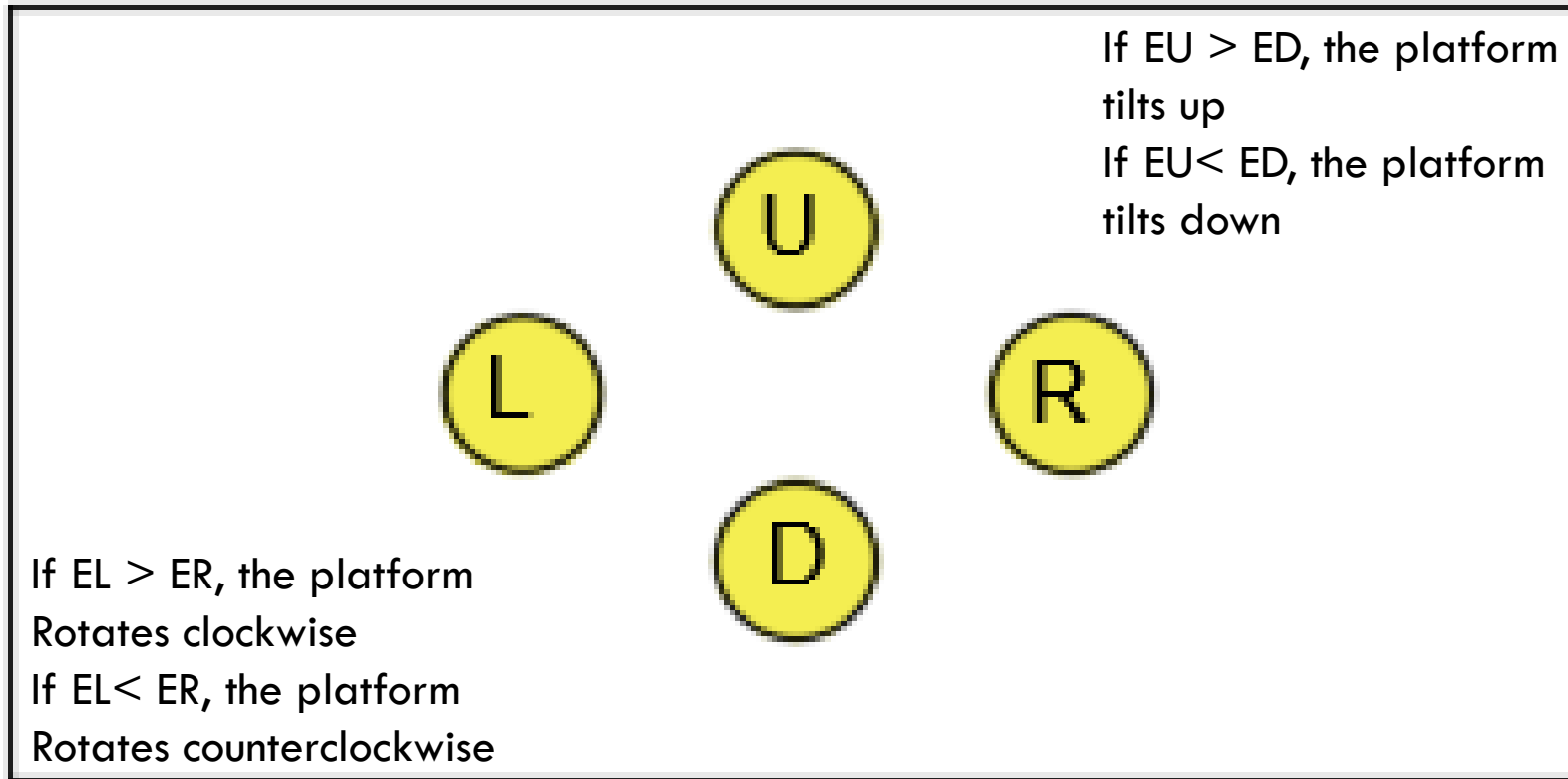


Wearable tag, that is worn by the target, consists of an infrared emitter, which is constantly transmitting encrypted signal.

The device rotates the platform around two axes so that the angle between the light rays coming from the transmitter and the surface of the platform approaches 90° .



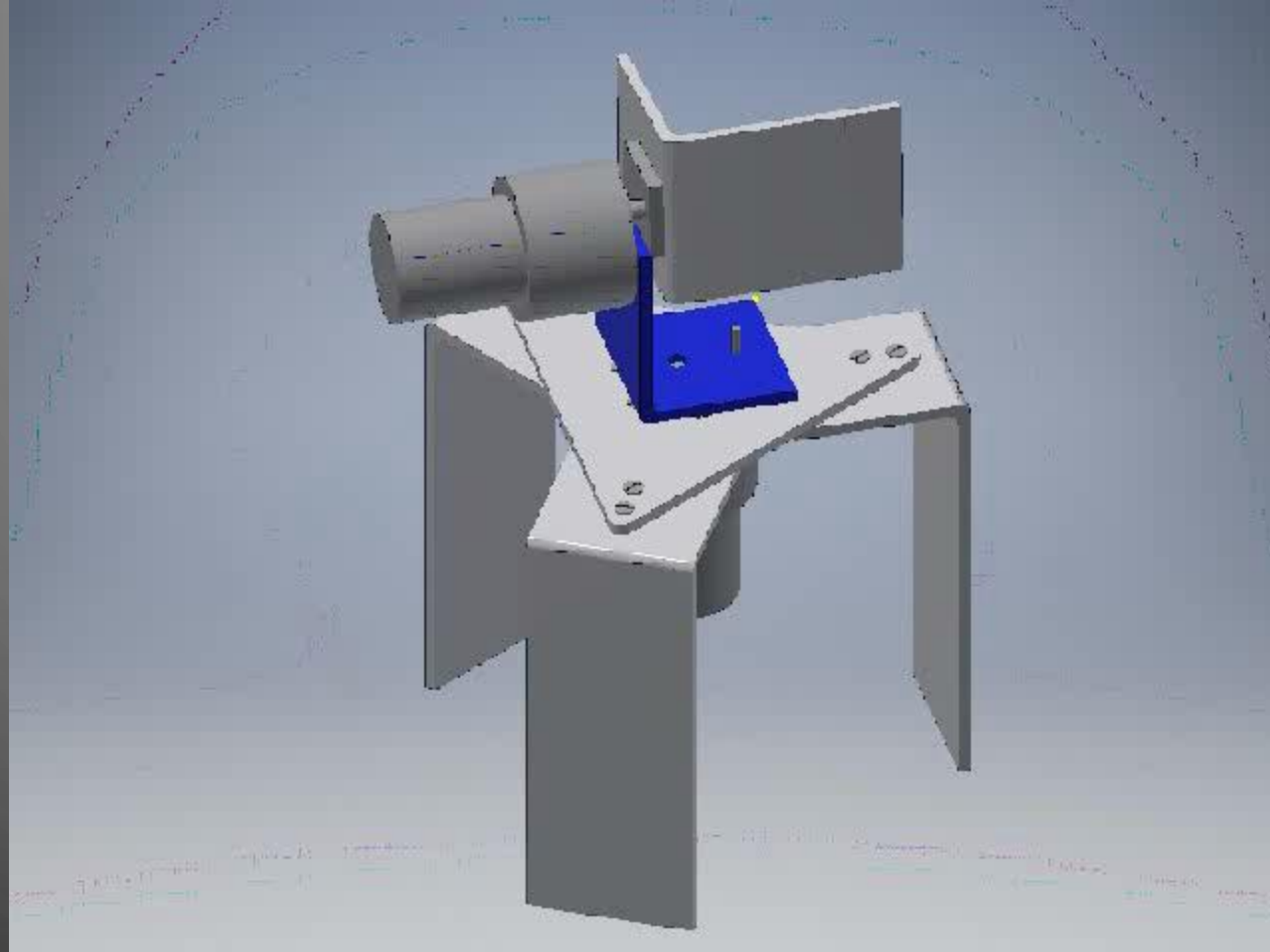
Phototransistor alignment



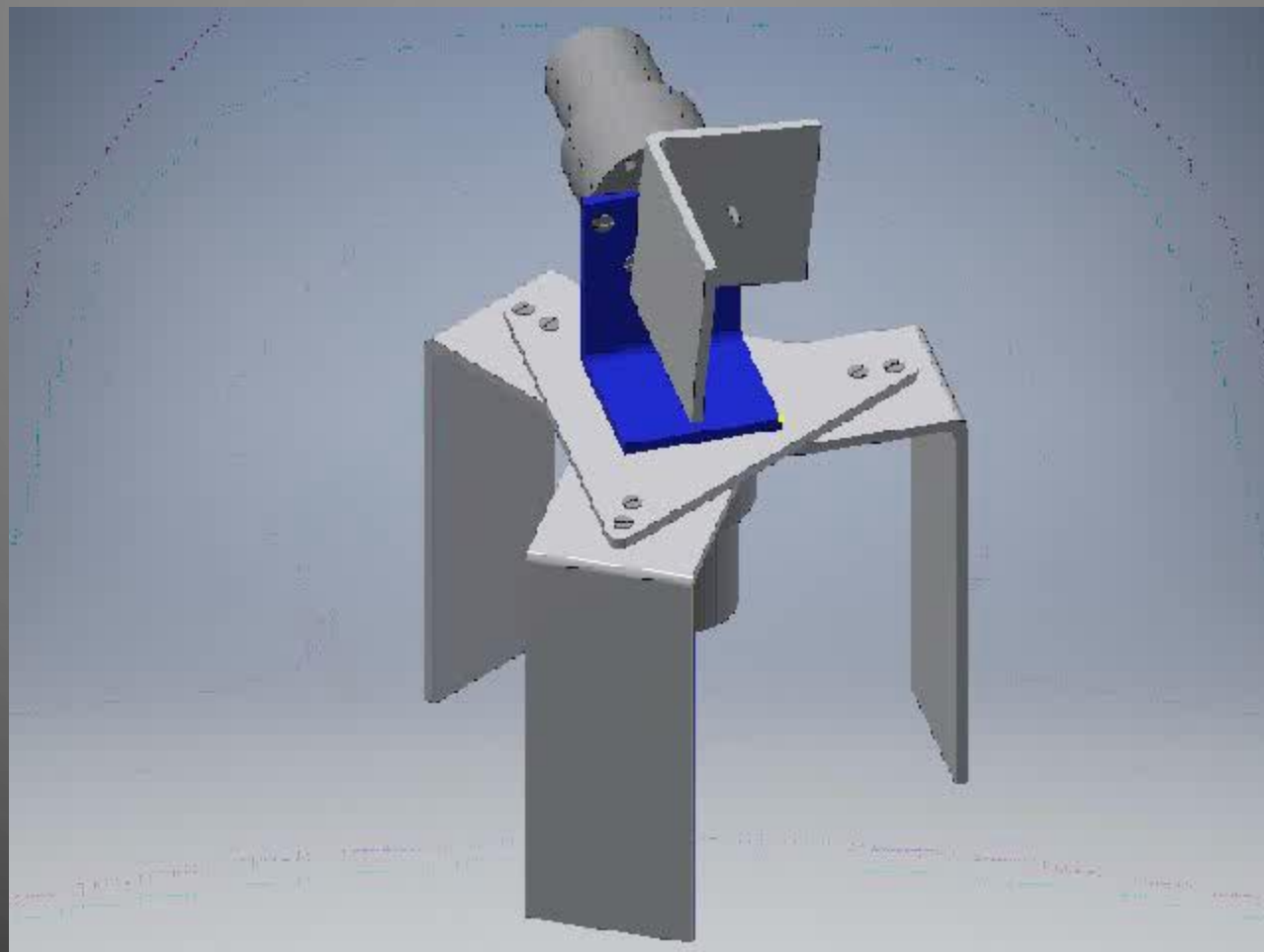
Finding starting point



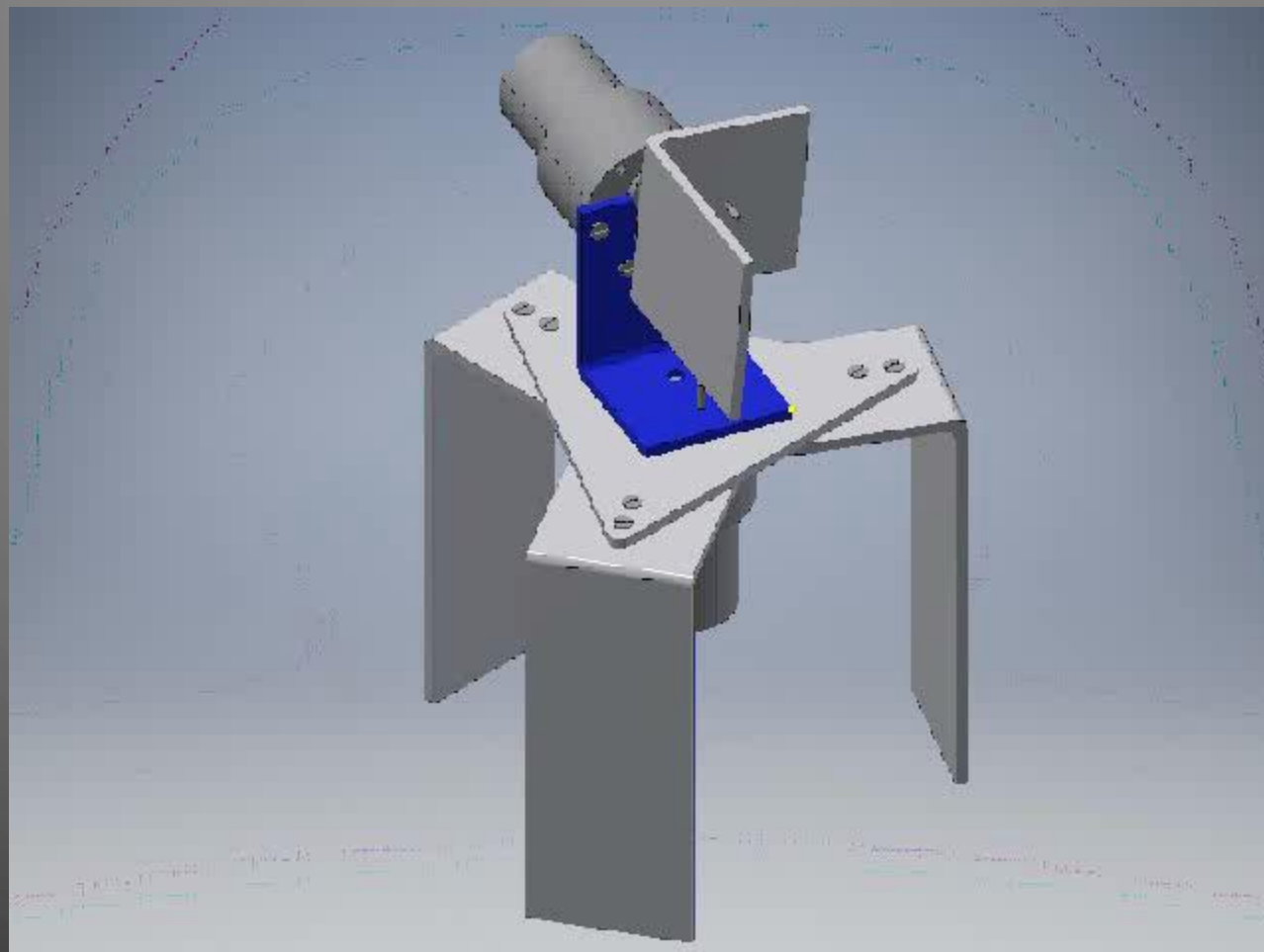
Limit switches
are installed on the
construction



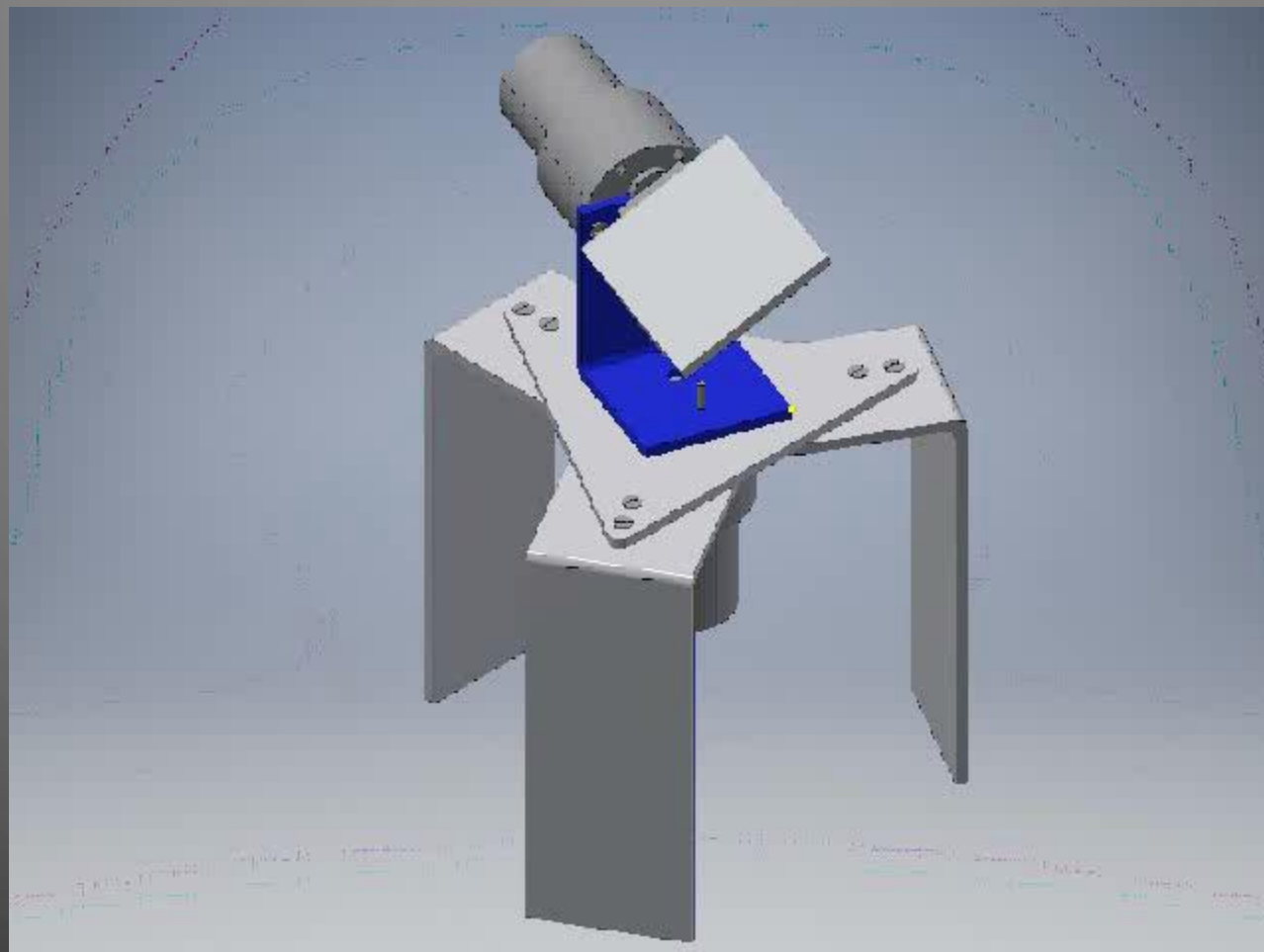
Finding starting point



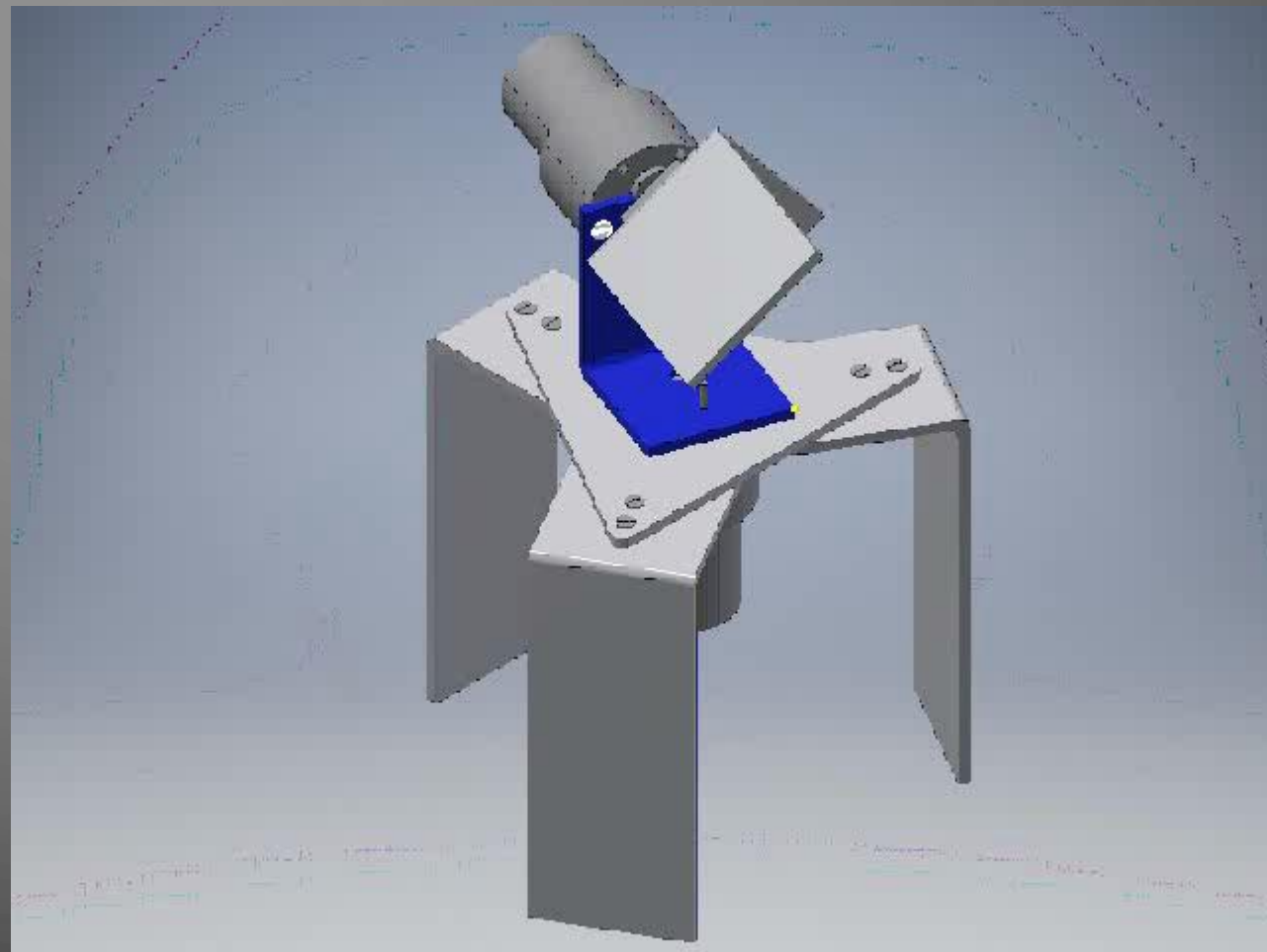
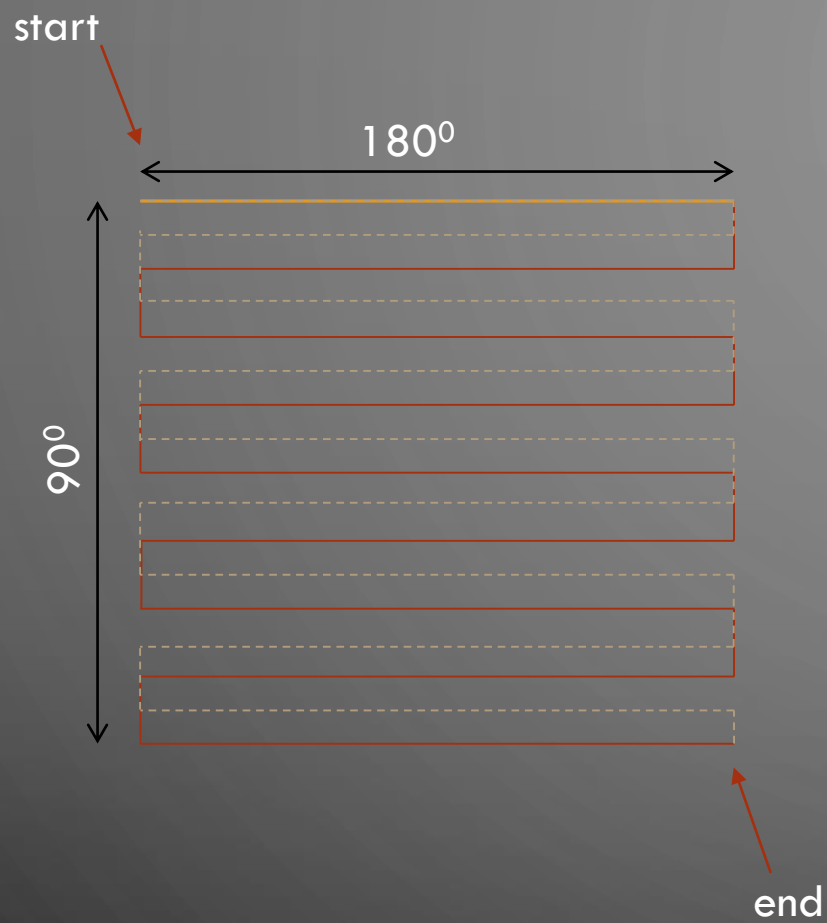
Finding starting point



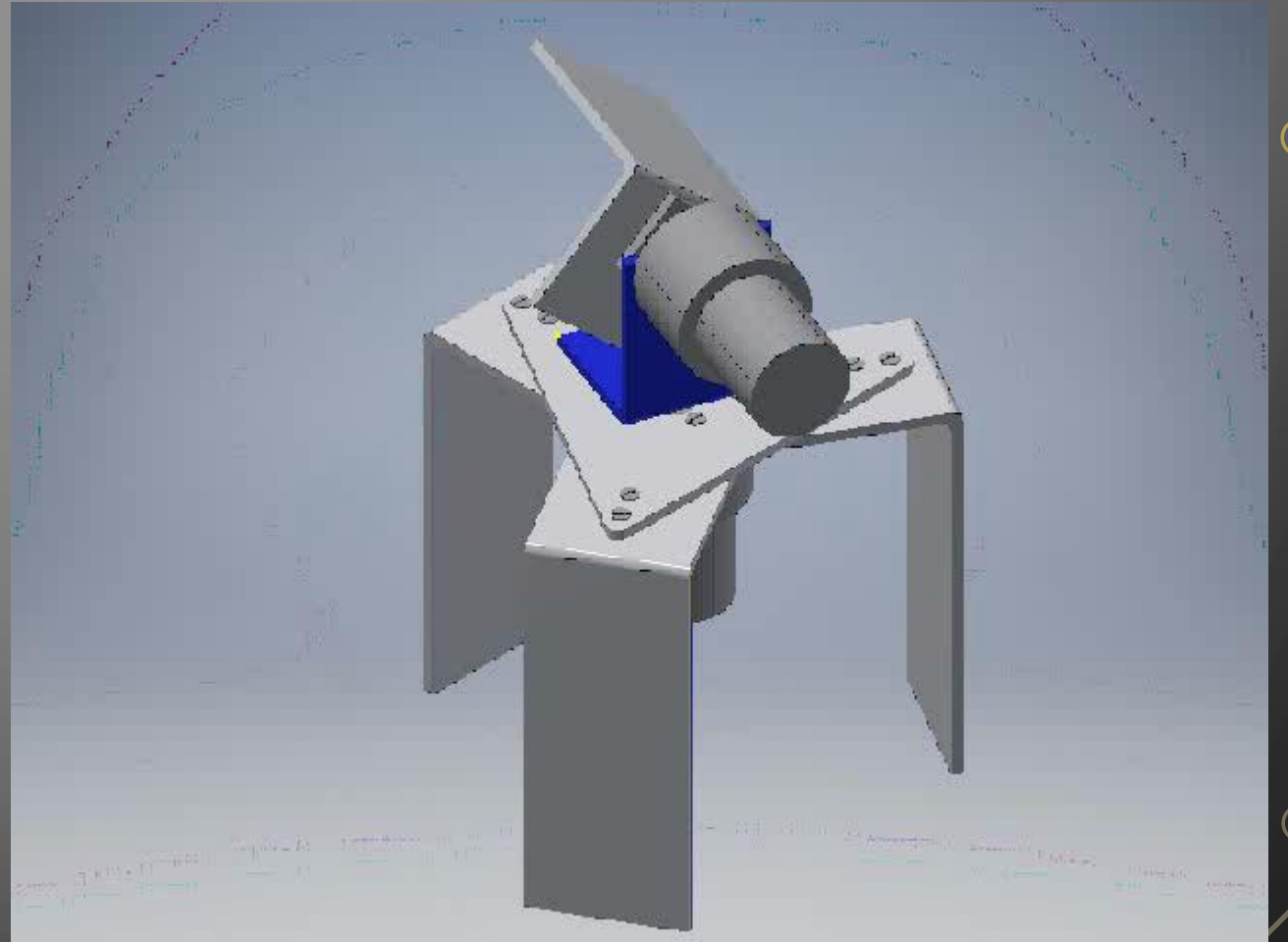
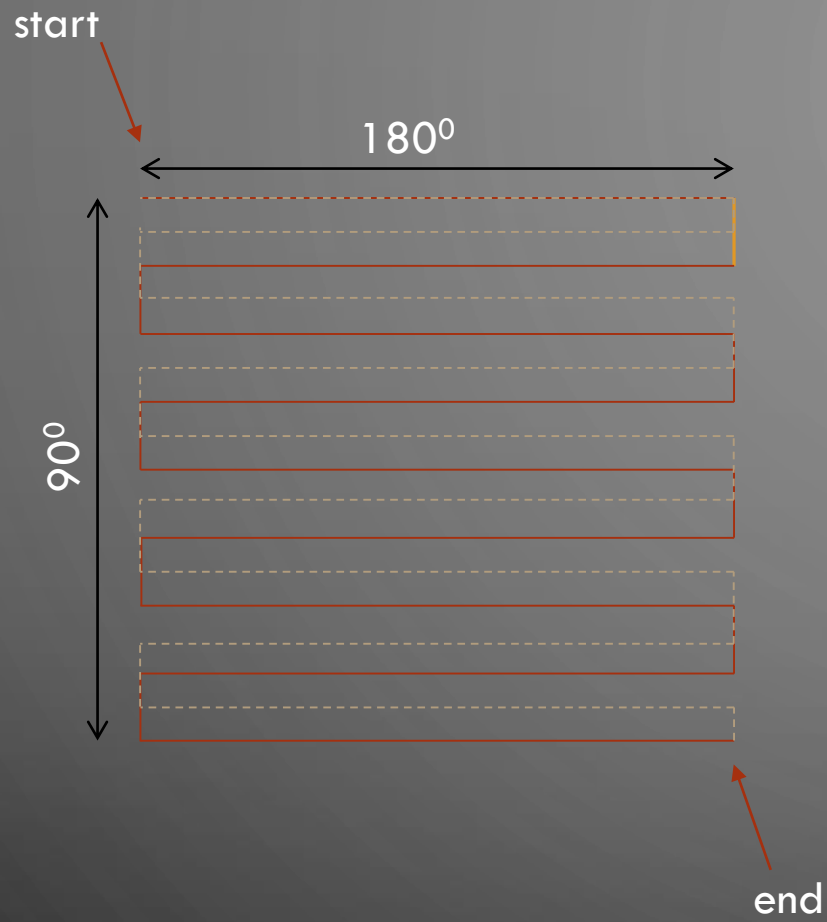
Finding starting point



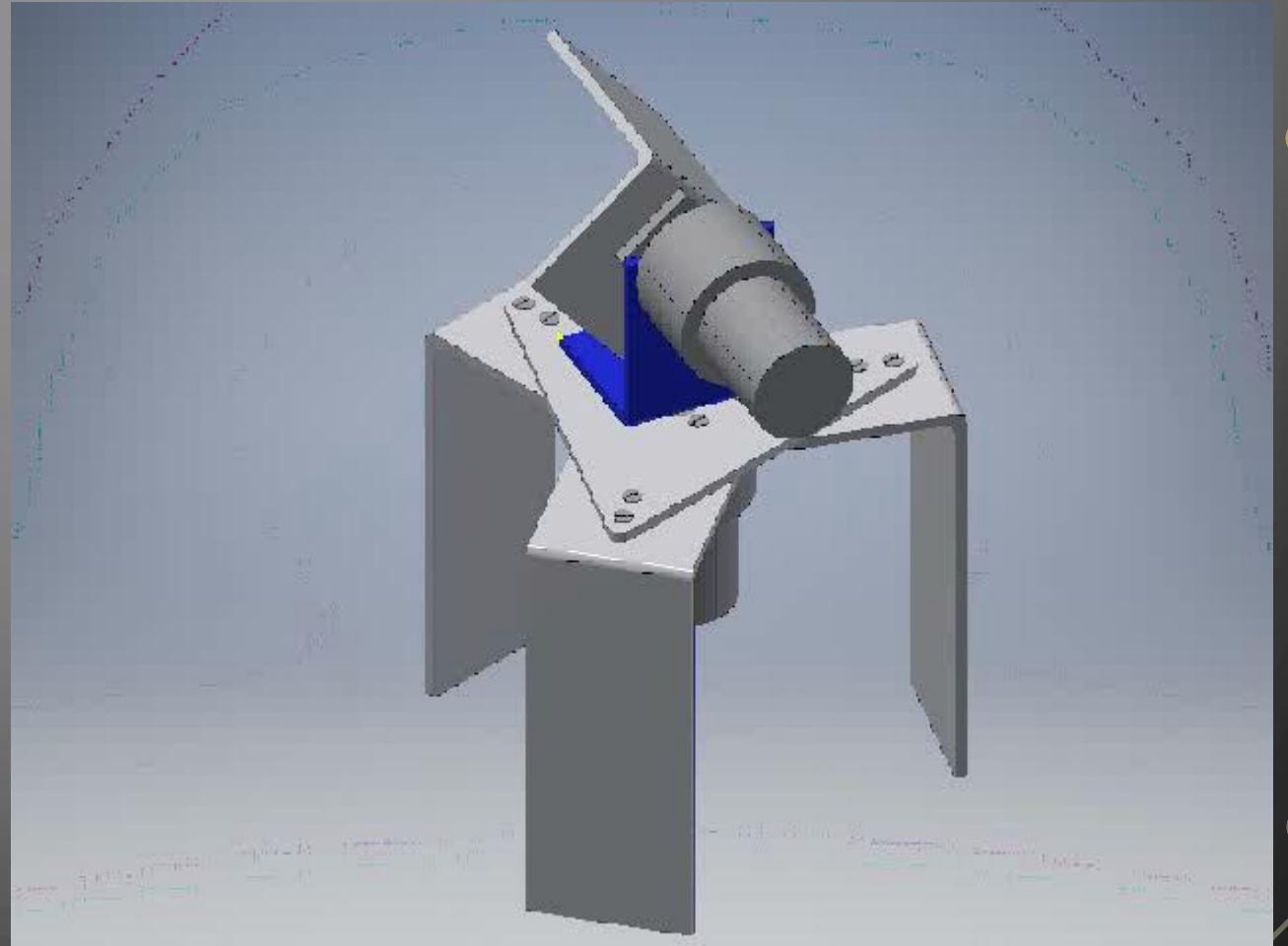
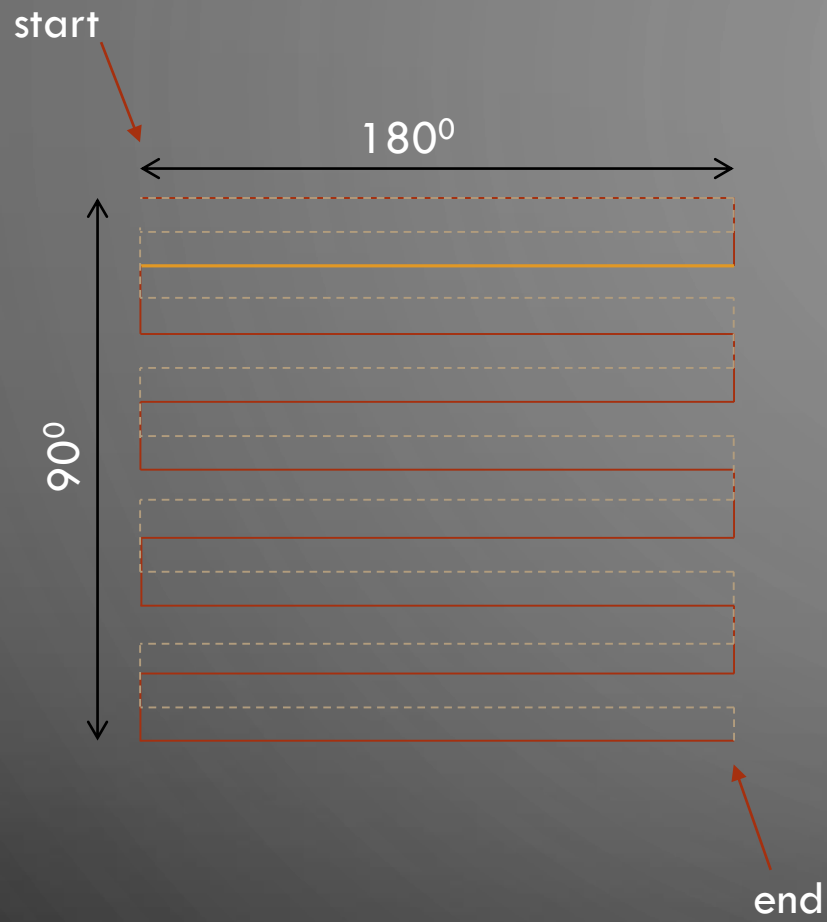
Searching trajectory



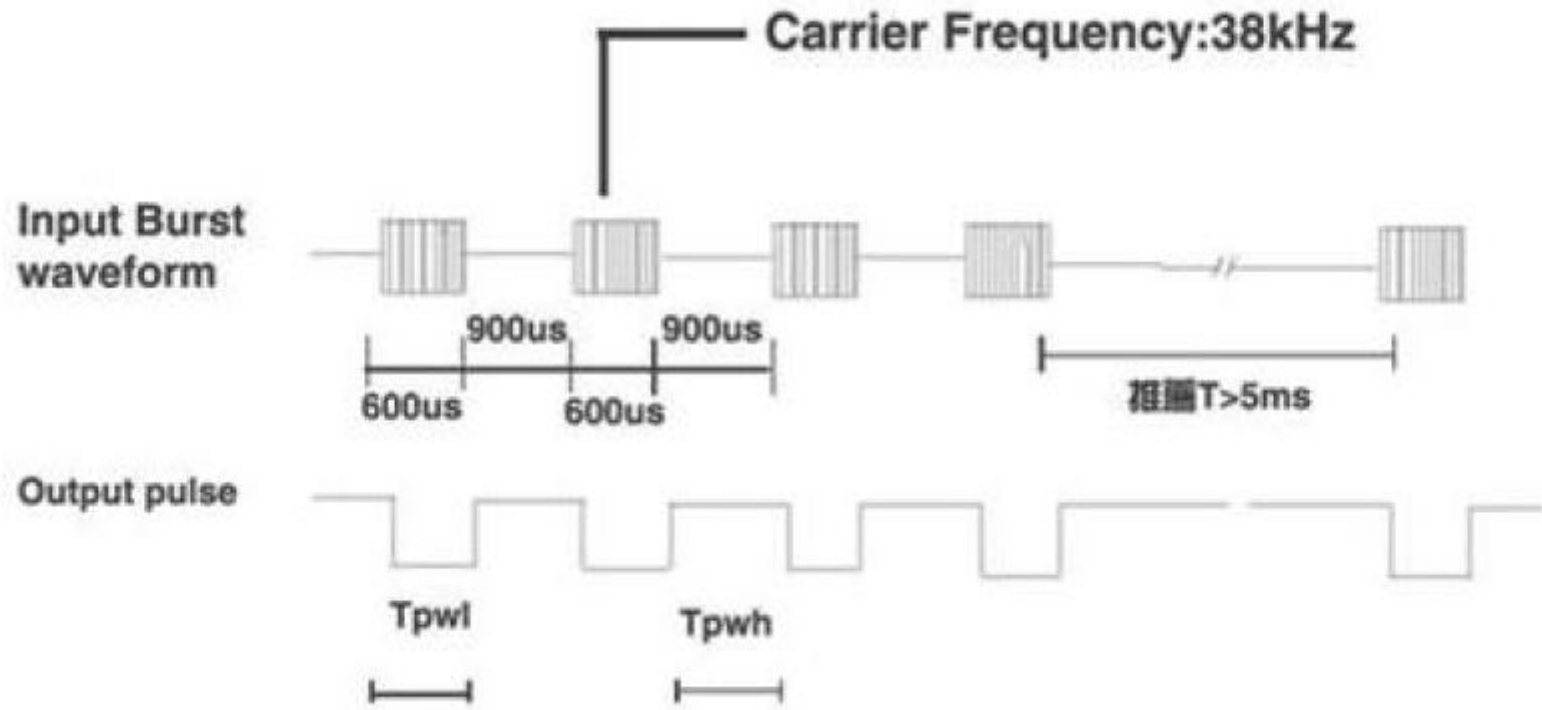
Searching trajectory



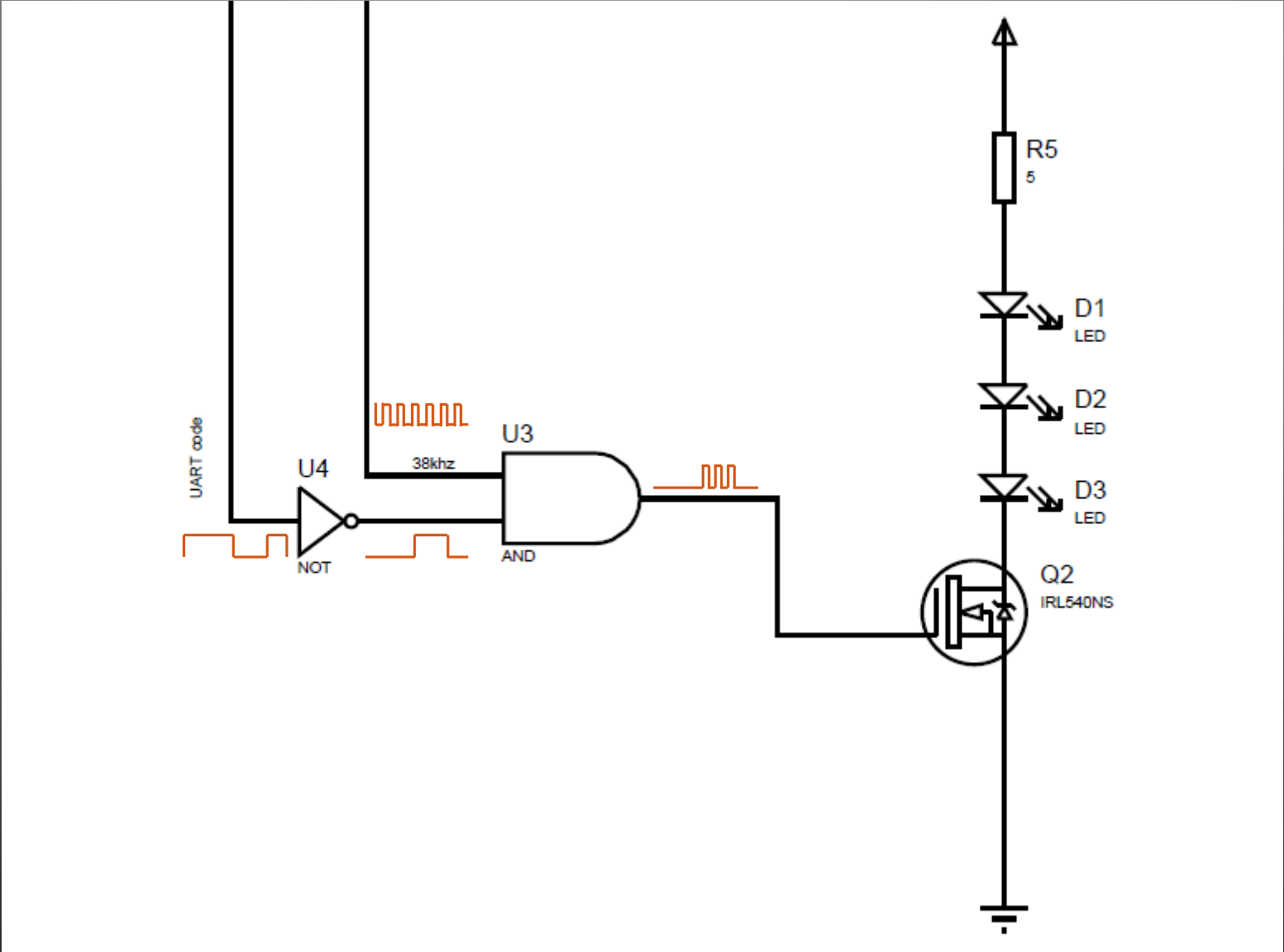
Searching trajectory



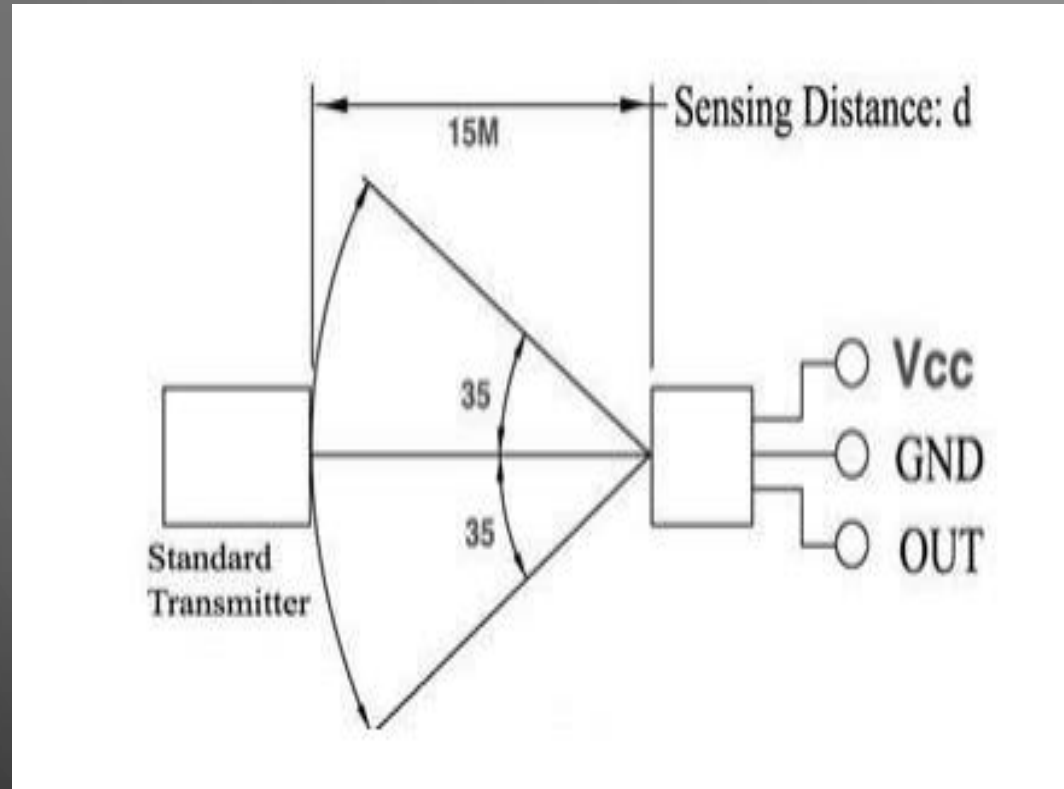
IR modulation



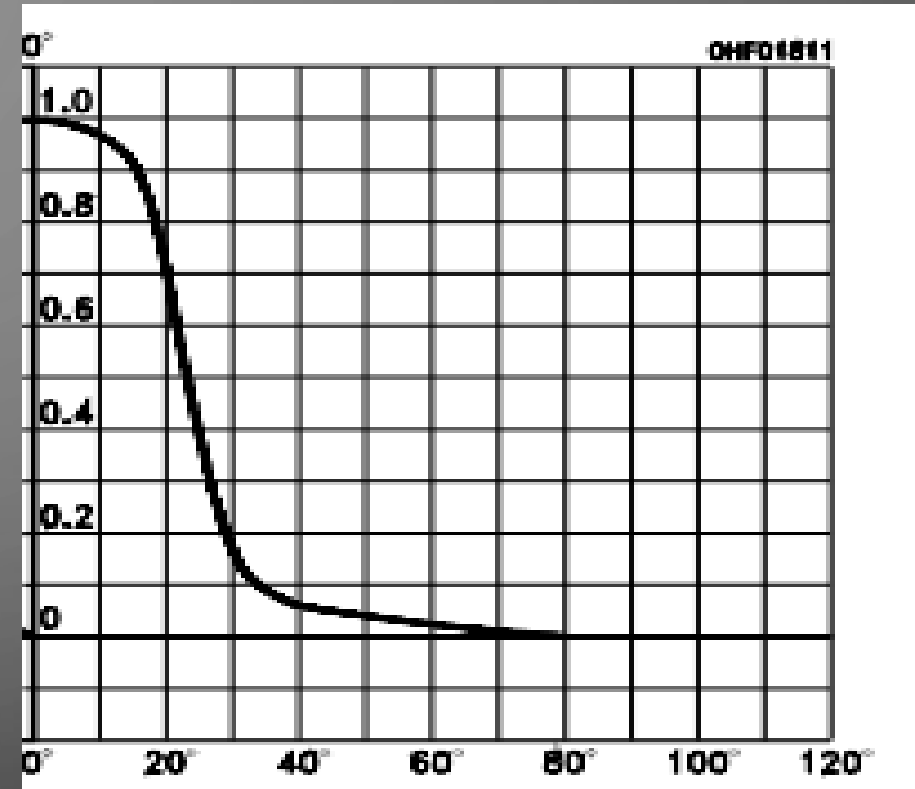
IR modulation



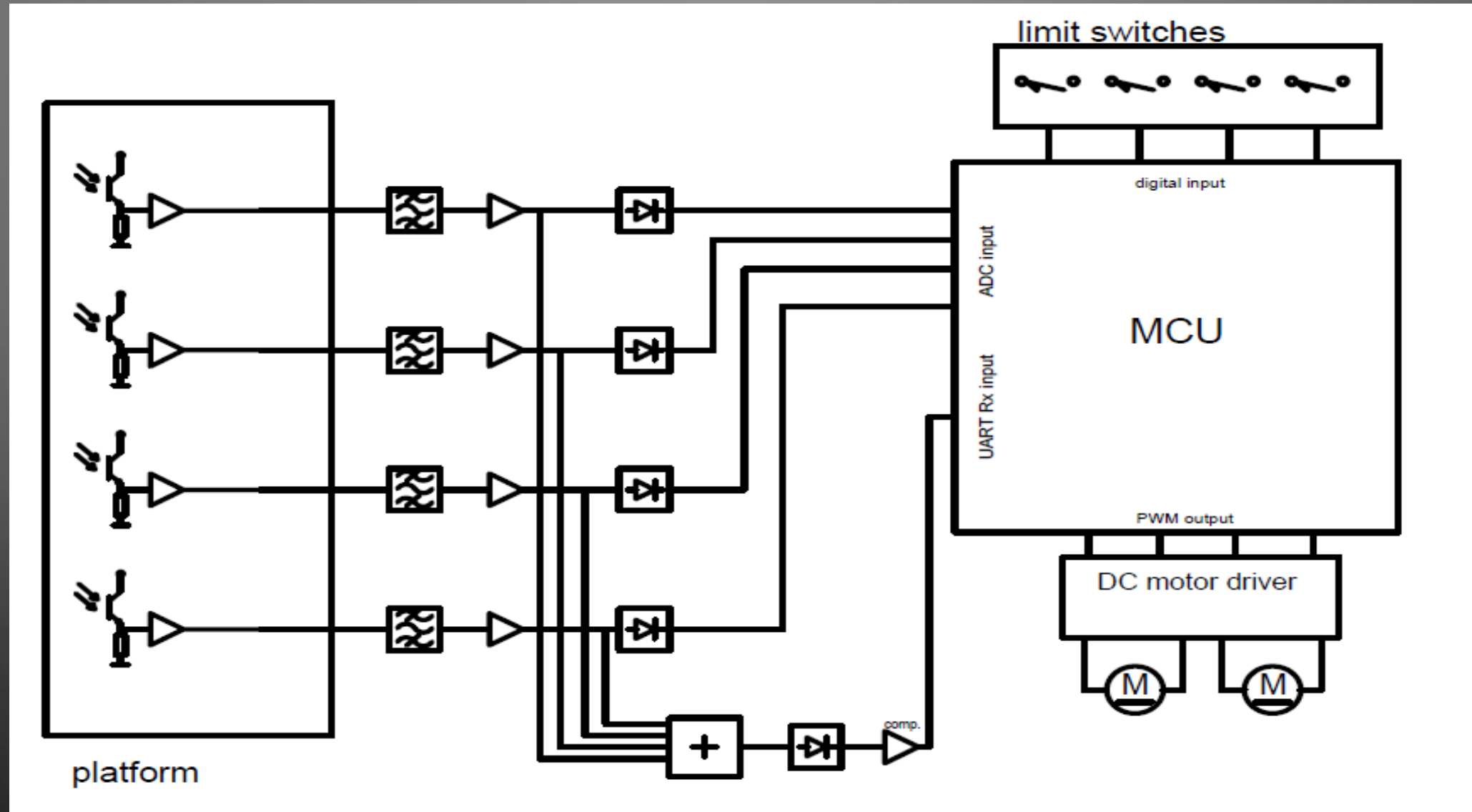
Digital infrared receiver's sensing angle is 35°



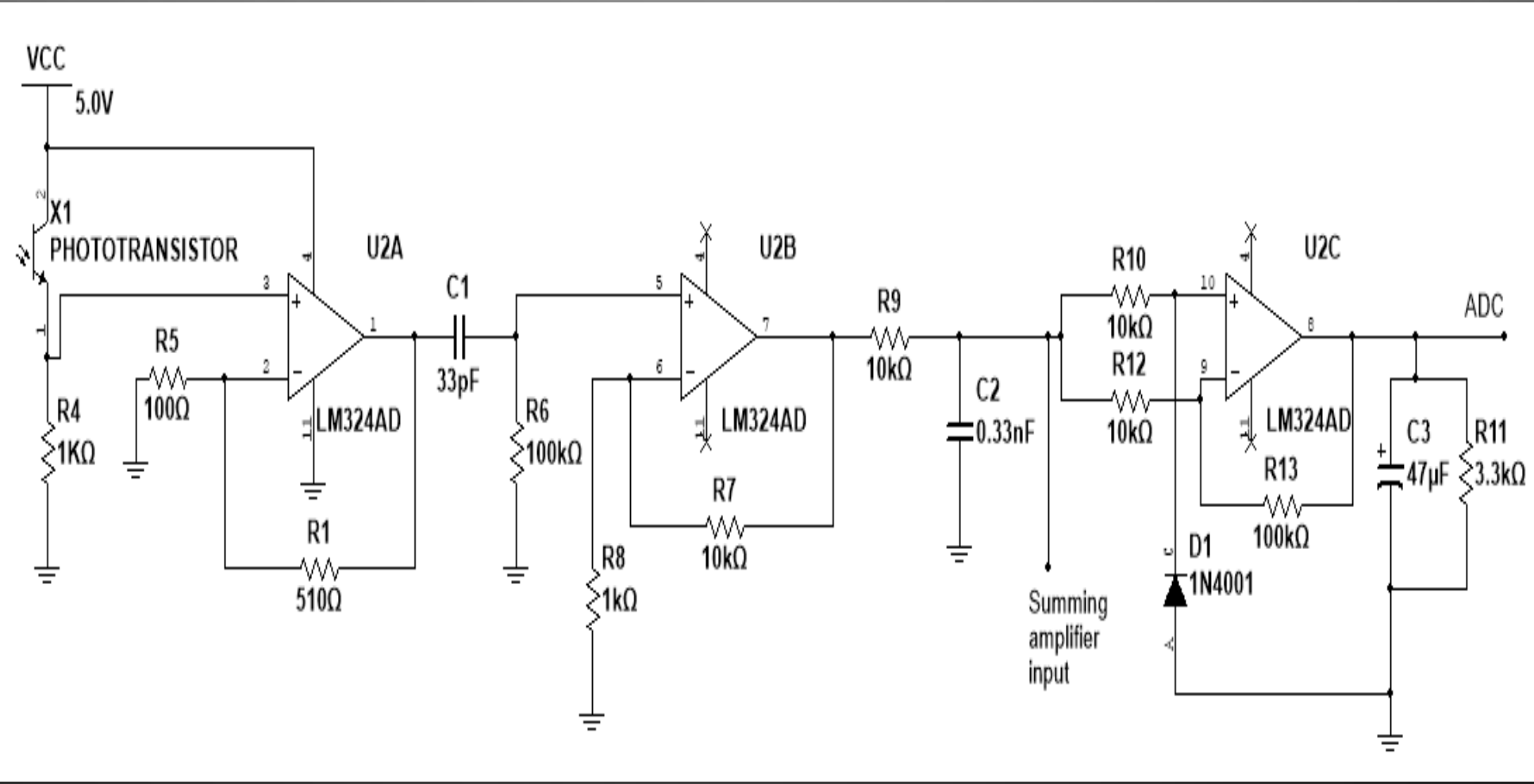
Phototransistor's sensitivity is very low for light that is directed at more than 20°



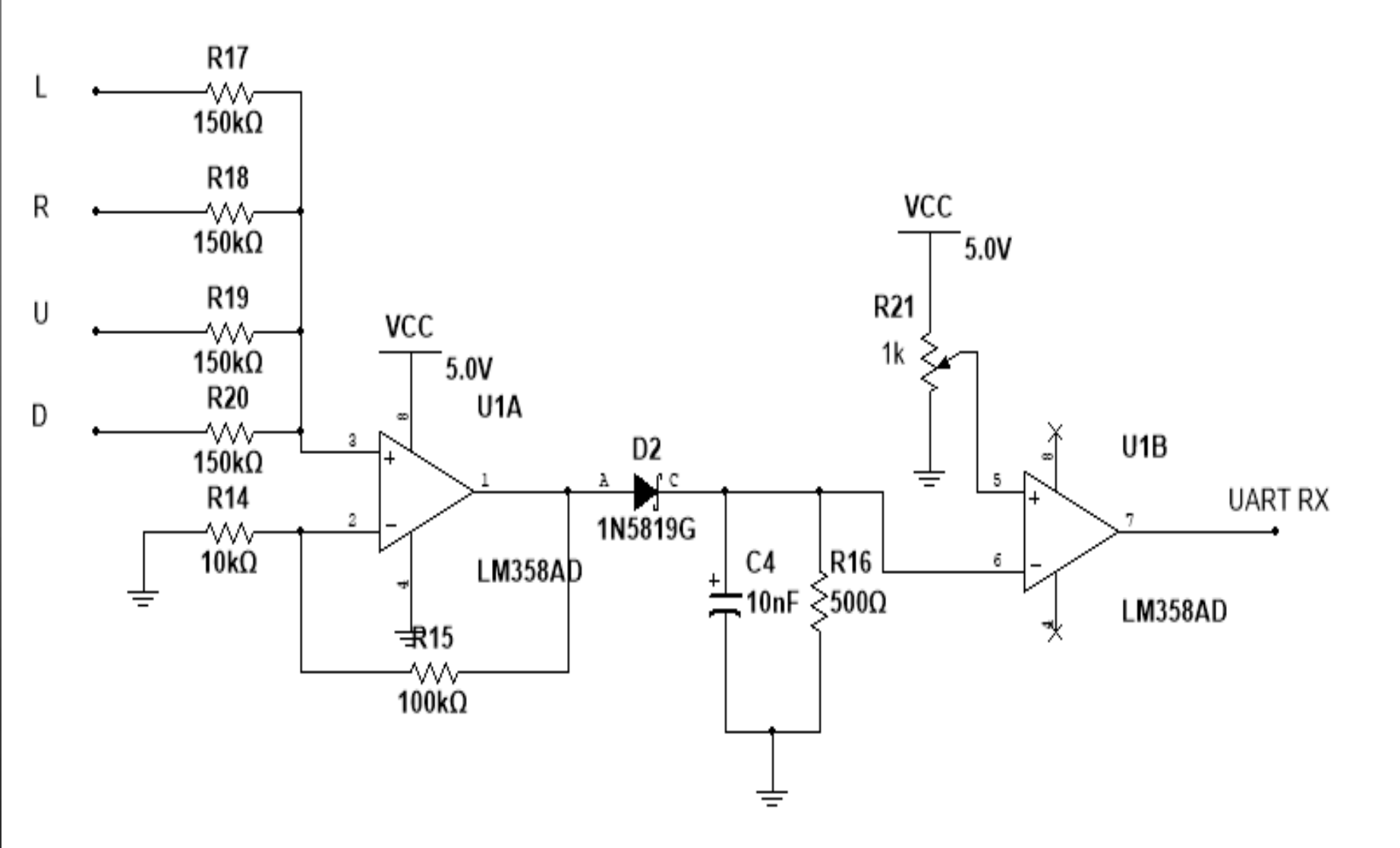
Block diagram



Electrical circuit

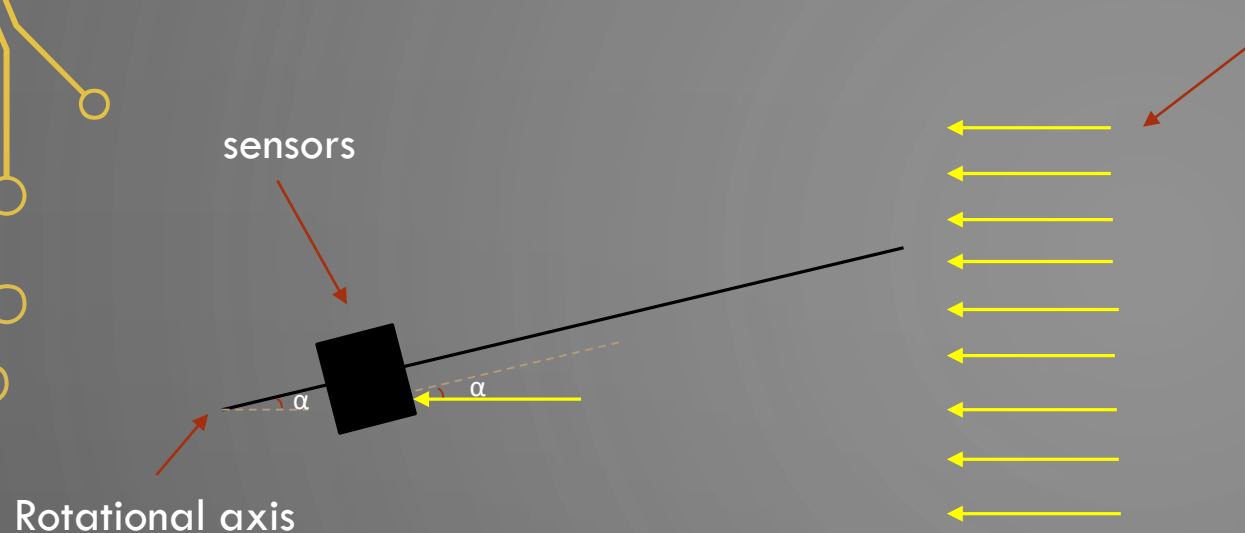


Electrical circuit



Modeling the system for a single axis input-output relationships to determine:

- Angle relative to the transmitter θ – phototransistor outputs_ $V_p=f(\theta)$
- Electrical circuit _ $V_{out}=f(V_p)$
- DC motor _ $\omega=f(V_{in})$

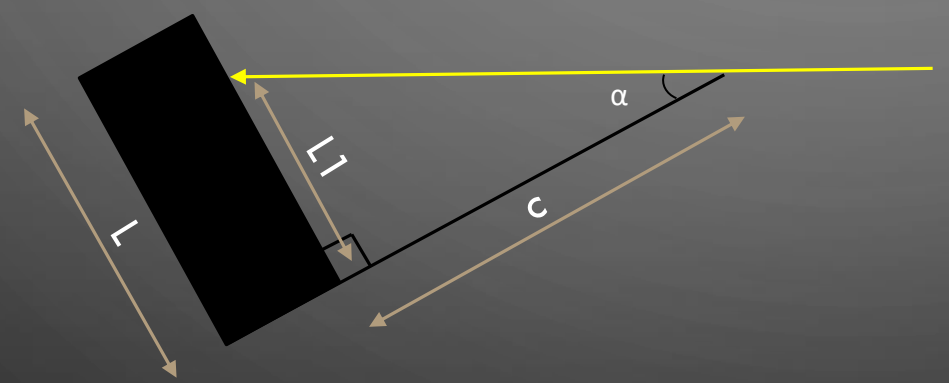


Rotational axis

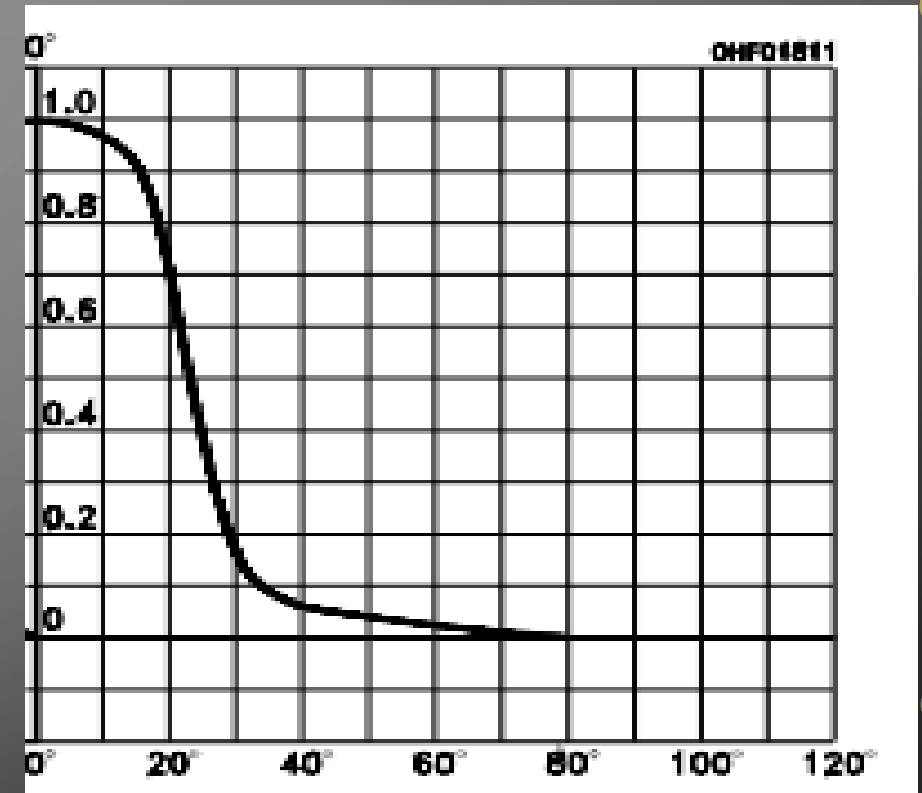
sensors

Light coming from the transmitter

L1 _ length of the shadow



$$L1 = ctg\alpha$$



Simulating DC motor

Back emf, $E \sim \omega$

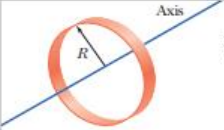
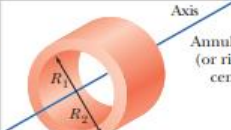
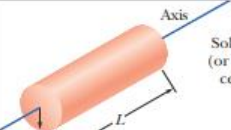
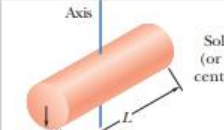

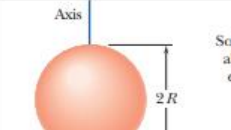
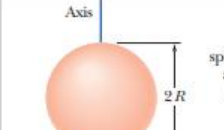
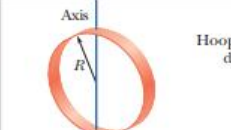
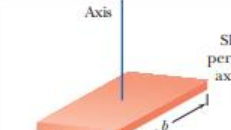
$$V = E + IR$$

When $E = 0$, $V = IR$

For approximating inertia:

Table 10-2

Some Rotational Inertias

 <p>Hoop about central axis</p> <p>$I = MR^2$ (a)</p>	 <p>Annular cylinder (or ring) about central axis</p> <p>$I = \frac{1}{2}M(R_1^2 + R_2^2)$ (b)</p>	 <p>Solid cylinder (or disk) about central axis</p> <p>$I = \frac{1}{2}MR^2$ (c)</p>
 <p>Solid cylinder (or disk) about central diameter</p> <p>$I = \frac{1}{4}MR^2 + \frac{1}{12}ML^2$ (d)</p>	 <p>Thin rod about axis through center perpendicular to length</p> <p>$I = \frac{1}{12}ML^2$ (e)</p>	 <p>Solid sphere about any diameter</p> <p>$I = \frac{2}{5}MR^2$ (f)</p>
 <p>Thin spherical shell about any diameter</p> <p>$I = \frac{2}{3}MR^2$ (g)</p>	 <p>Hoop about any diameter</p> <p>$I = \frac{1}{2}MR^2$ (h)</p>	 <p>Slab about perpendicular axis through center</p> <p>$I = \frac{1}{12}M(a^2 + b^2)$ (i)</p>

Block Parameters: DC Motor

speed and stall torque. If no information is available on armature inductance, this parameter can be set to some small non-zero value.

When a positive current flows from the electrical + to - ports, a positive torque acts from the mechanical C to R ports. Motor torque direction can be changed by altering the sign of the back-emf or torque constants.

Settings

Electrical Torque Mechanical

Model parameterization: By equivalent circuit parameters

Armature resistance: 6.38 Ohm

Armature inductance: 1e-7 H

Define back-emf or torque constant: Specify back-emf constant

Back-emf constant: 0.26 V/rpm

Rotor damping parameterization: By no-load current

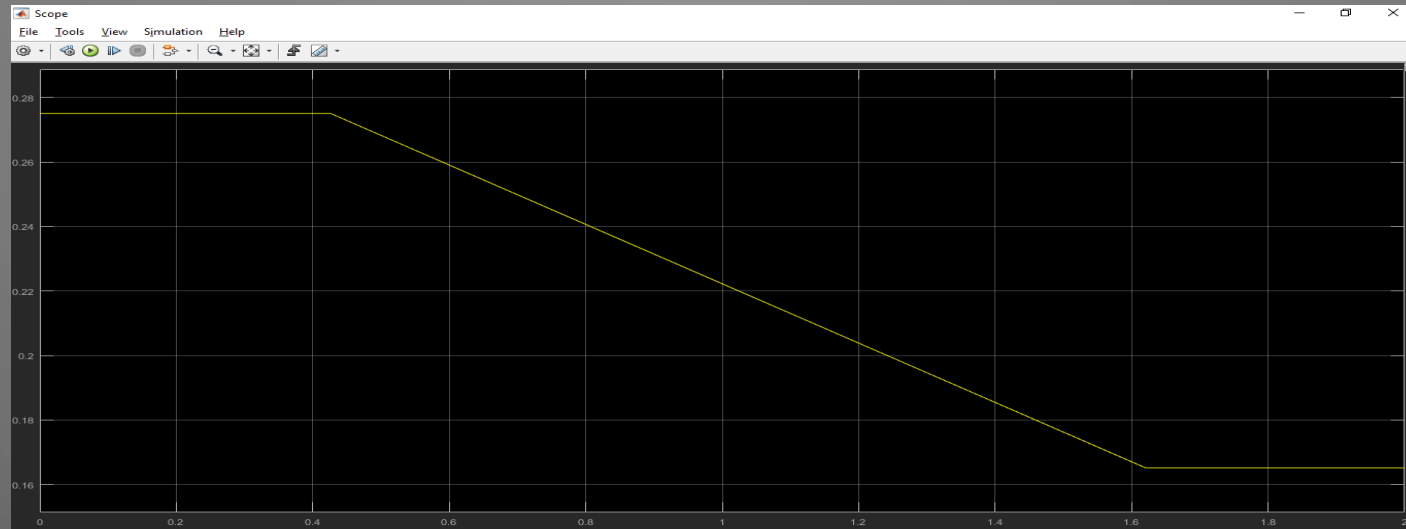
No-load current: 0.1 A

DC supply voltage when measuring no-load current: 1.5 V

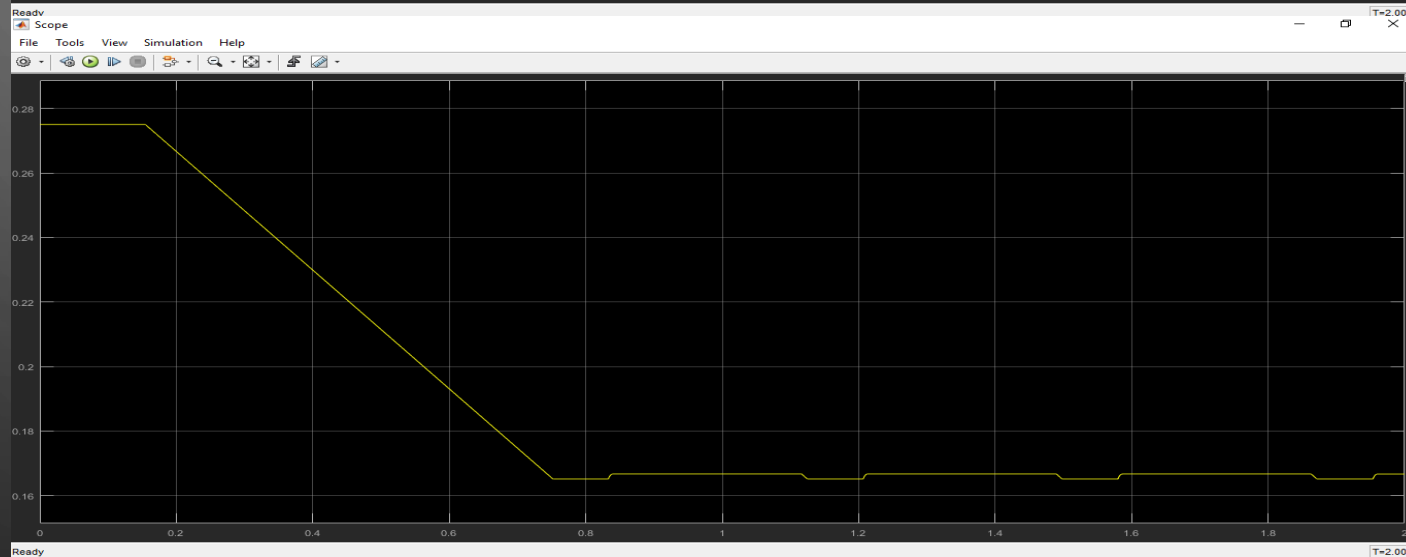
OK Cancel Help Apply

Source: Halliday _ fundamentals of physics

Simulation results

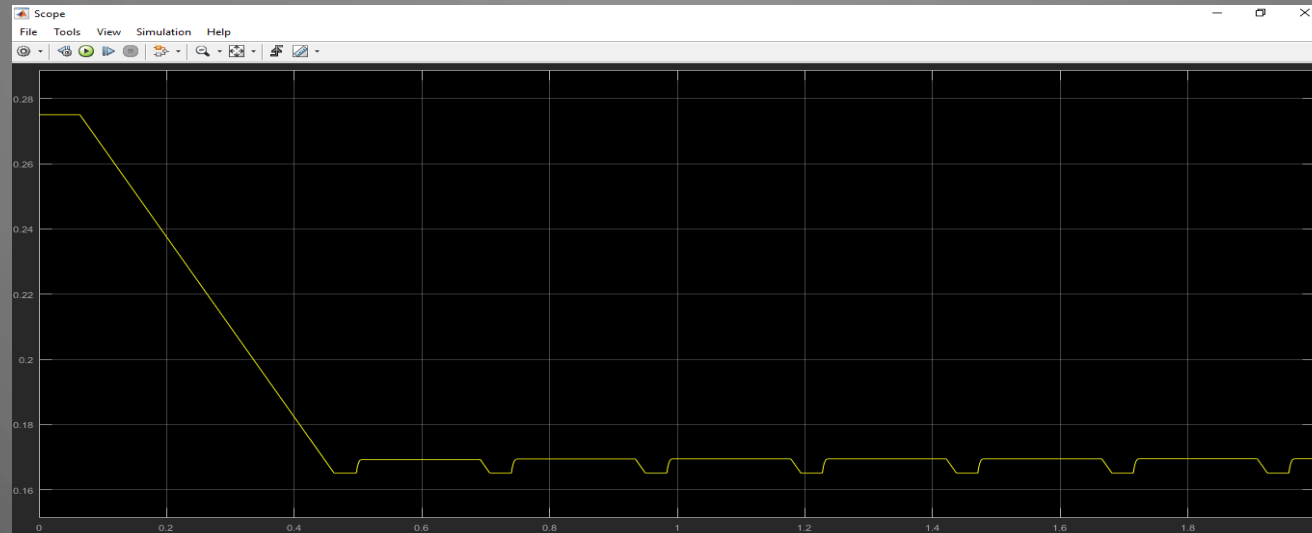


$K_p = 100$

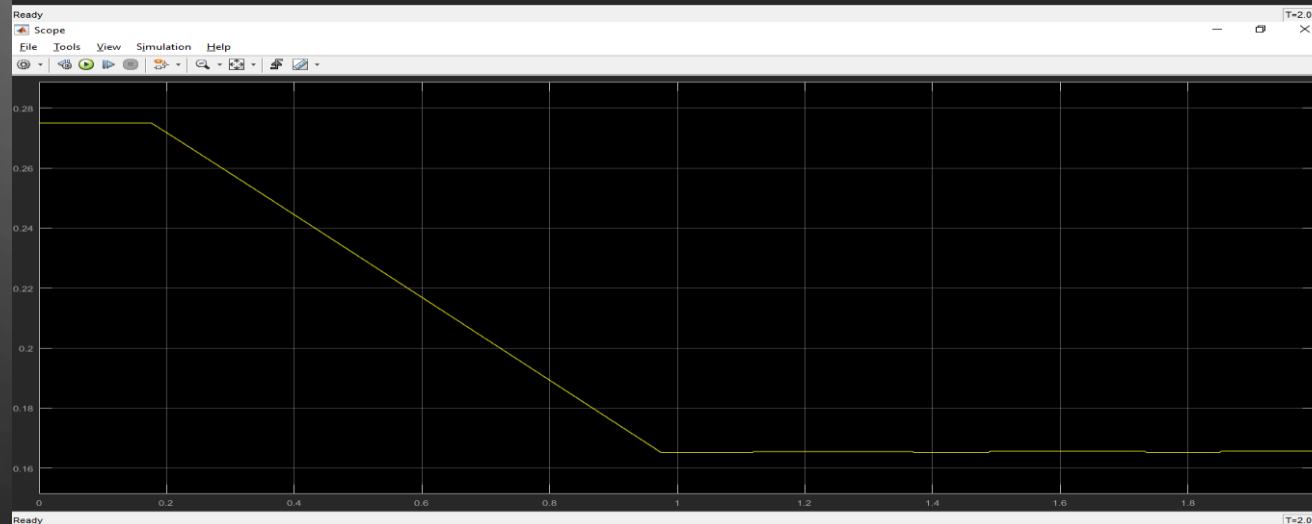


$K_p = 200$

Simulation results



$K_p = 300$



$K_p = 150$
 $K_d = 10$

The slide features a dark gray background with decorative circuit board patterns in the corners. The top-left and bottom-left corners have yellow circuit traces, while the top-right and bottom-right corners have white circuit traces. The central text is white.

Future plans

- Install lenses for phototransistors
- Reduce electrical noise
- Add sensors to measure position

The image features a dark gray background with a subtle pattern of concentric circles. In the four corners, there are decorative elements consisting of yellow and white lines that resemble circuit traces or a stylized tree structure, ending in small circles.

Thank you for your attention