ORGANIZERS:

ASSOCIATION FOR MULTIDISCIPLINARY RESEARCH IN WEST ZONE OF ROMANIA (ACM-V) – TIMISOARA

UNIVERSITY POLITEHNICA – TIMISOARA, FACULTY OF ENGINEERING – HUNEDOARA

GENERAL ASSOCIATION OF THE ROMANIAN ENGINEERS (AGIR) – Branch of HUNEDOARA

in collaboration with our international traditional partners:

HUNGARIAN ACADEMY OF SCIENCE - branch of SZEGED, HUNGARY

UNIVERSITY OF NOVI SAD, NOVI SAD, SERBIA

with financial support of:

ROMANIAN MINISTRY OF EDUCATION, RESEARCH AND INNOVATION

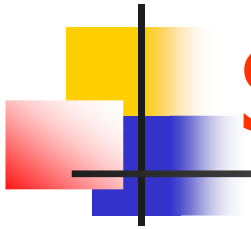
NATIONAL AUTHORITY FOR SCIENTIFIC RESEARCH

with logistical support of:

RETEZAT NATIONAL PARK ROMANIA

ANNALS OF FACULTY ENGINEERING HUNEDOARA – JOURNAL OF ENGINEERING

Optički davači (interfejsi) – Sadržaj

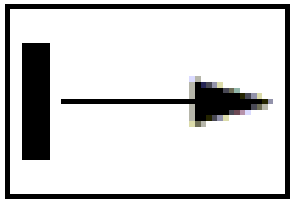


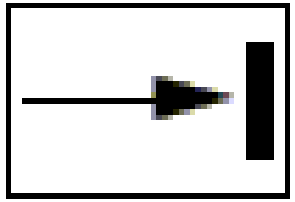
- Vrste
- Primjena
- Enkoderi – davači položaja

Optički senzori se po načinu funkcionisanja realizuju kao:

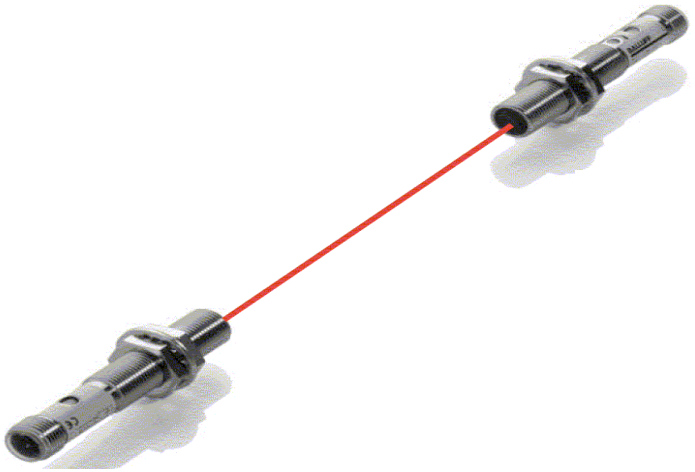
- **Transmisioni** (prolazni) senzori
- **Refleksioni** (odbijajuci) senzori
  - refleksija=odbijanje, odražavanje
- **Difuzioni senzori**
  - difuzija=rasipanje, širenje, razlivanje
- **Distance-settable Sensors** (Senzori za procjenu rastojanja objekta)
- **Limited-reflective Sensors** (Senzori ograničene refleksije)

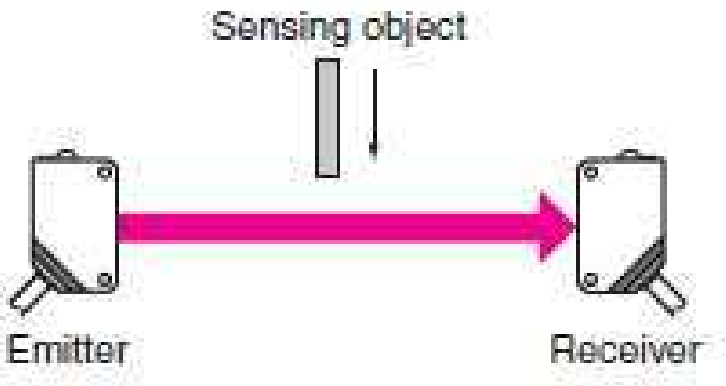
Prolazni (transmisioni ili thru beam) davač

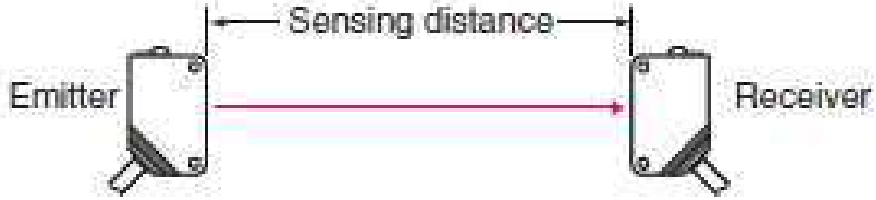




predajnik prijemnik

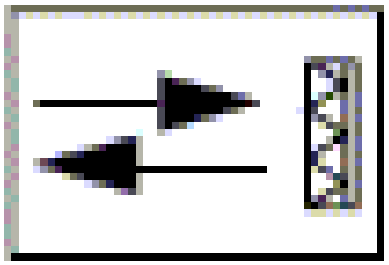




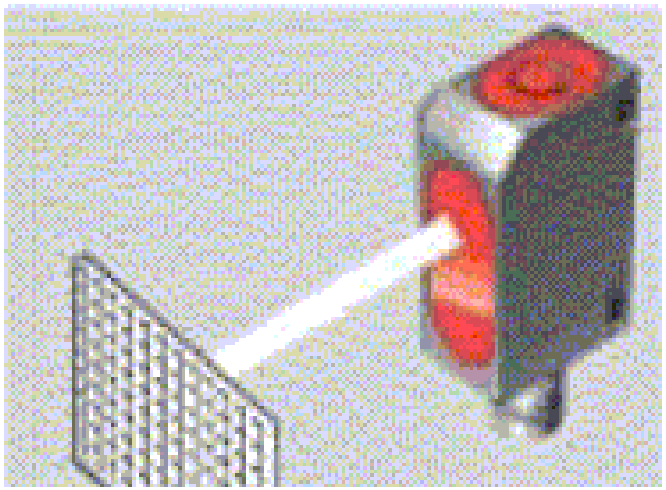


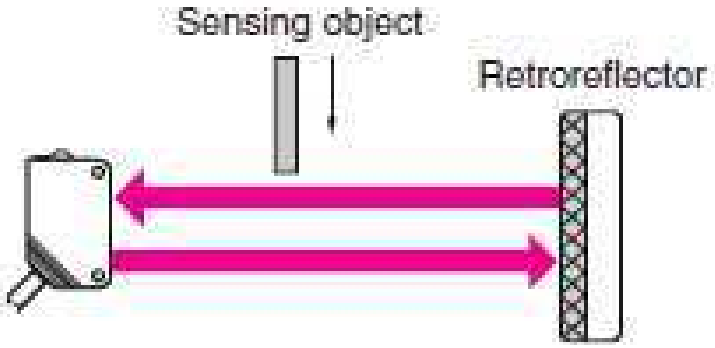
Mane: - Predajnik i prijemnik se moraju postaviti na odvojenim mjestima. - Moraju da se postavljaju zasebni kablovi za obje strane.

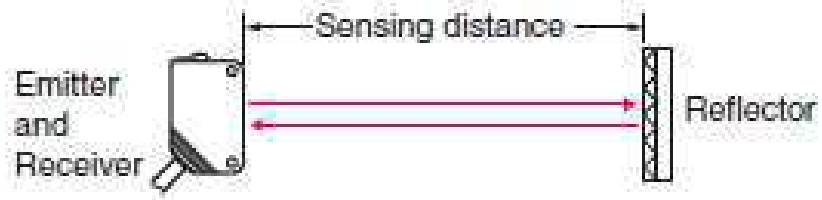
Odbijajući (retrorefleksioni) davači



Simbol za odbijajući davač

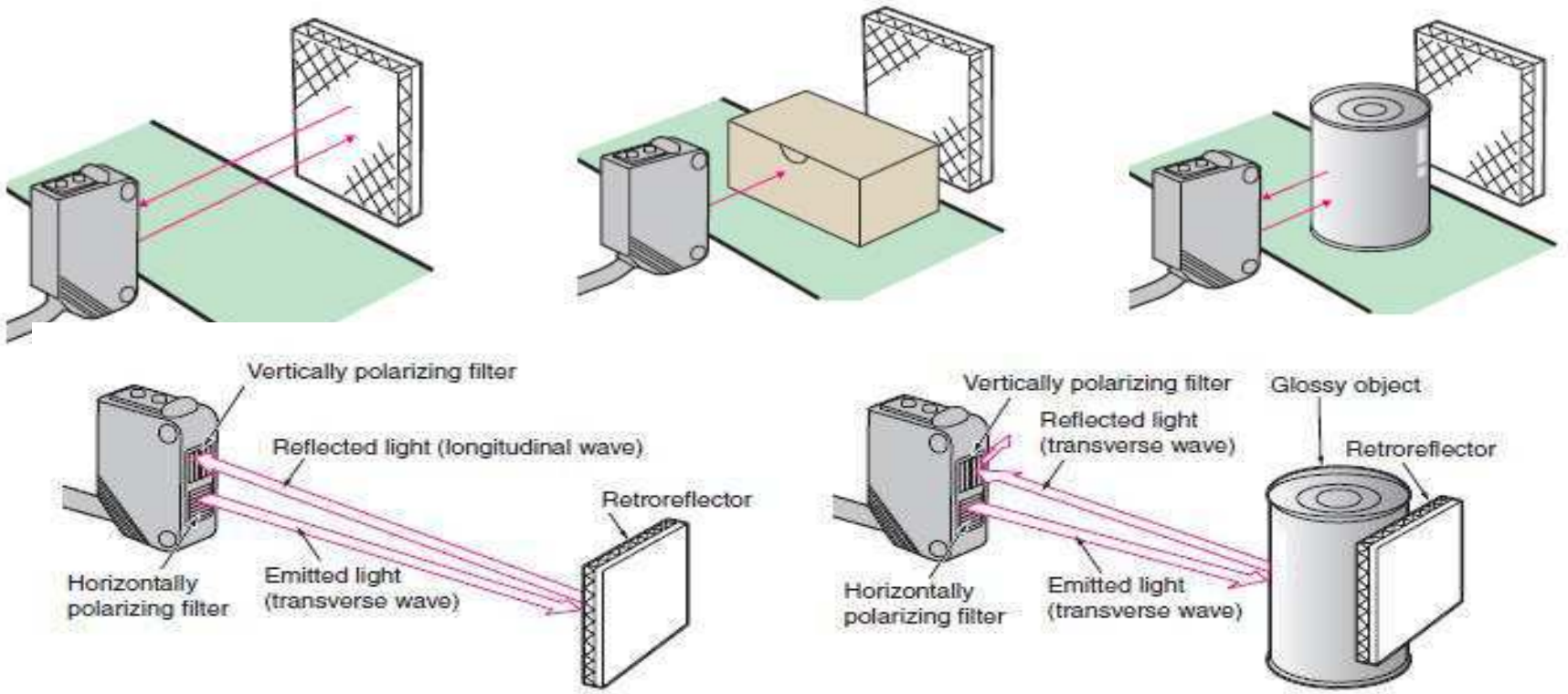






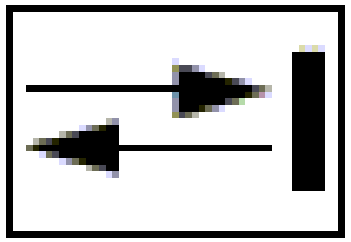
Predajnik i prijemnik su u istom kućištu, a sa druge strane je ogledalo koje odbija svjetlosni zrak nazad.

Odbijajući (retrorefleksioni) davači

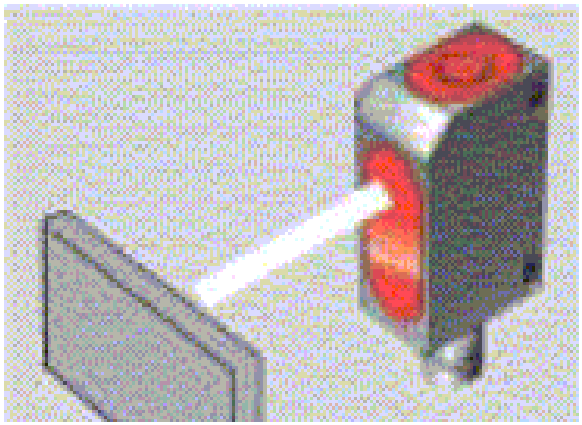


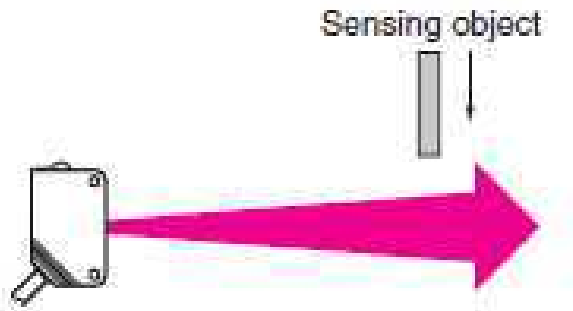
Predajnik emituje horizontalno polarizovanu svjetlost. Specijalno ogledalce vraća zrak sa zakrenutom (vertikalnom) polarizacijom kojeg prijemnik uspješno prima. Kada se zrak odbije od nekog drugog objekta, na prijemnik se vraća zrak sa horizontalnom polarizacijom koji neće biti primljen.

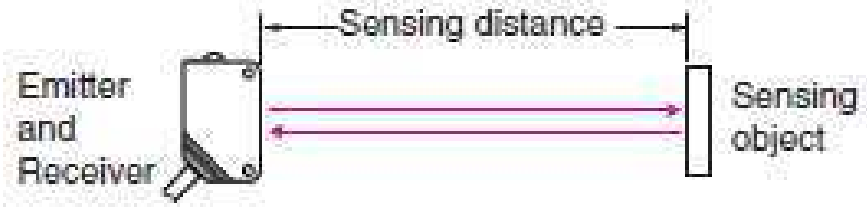
Difuzioni optički davač



Simbol za difuzioni davač

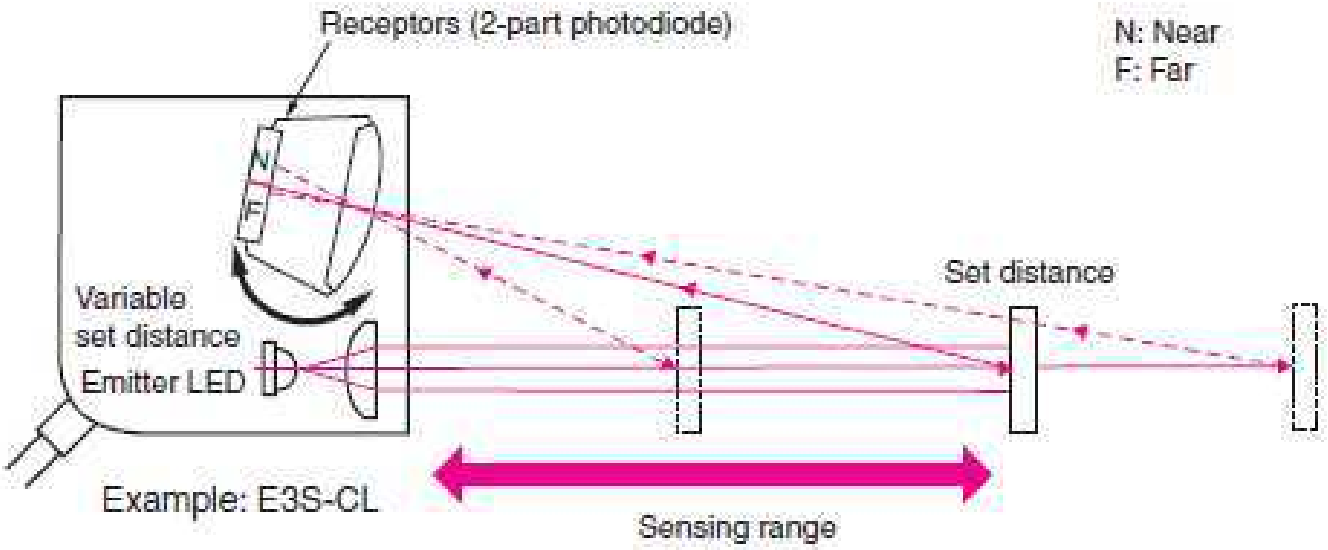






Sličan je odbijajućem davaču. Predajnik i prijemnik su u istoj kutiji. Međutim, ovdje se ne koristi ogledalce. Svjetlost se rasipa od objekta i detektuje u prijemniku.

Senzor za procjenu rastojanja objekta

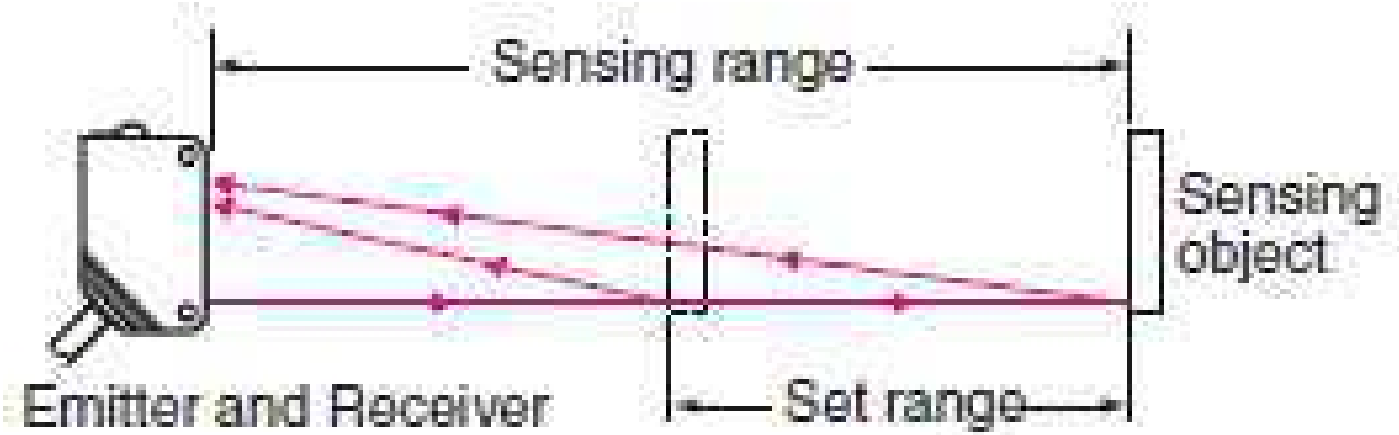


Prijemnik sezora je dvodjelna fotodioda ili pozicioni detektor.

Reflektovana svjetlost je koncentisana na dijelu prijemnika.

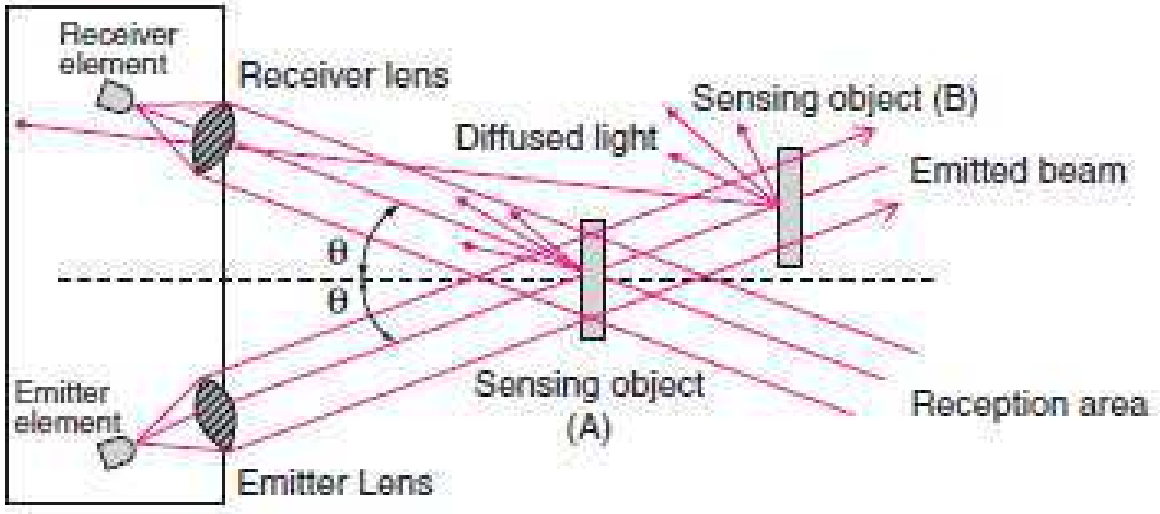
Detekcija je zasnovana na principu mjerenja ugla. Pozicija na kojoj ce reflektovana svjetlost biti koncentrisana zavisi od rastojanja objekta.

Senzor za procjenu rastojanja objekta



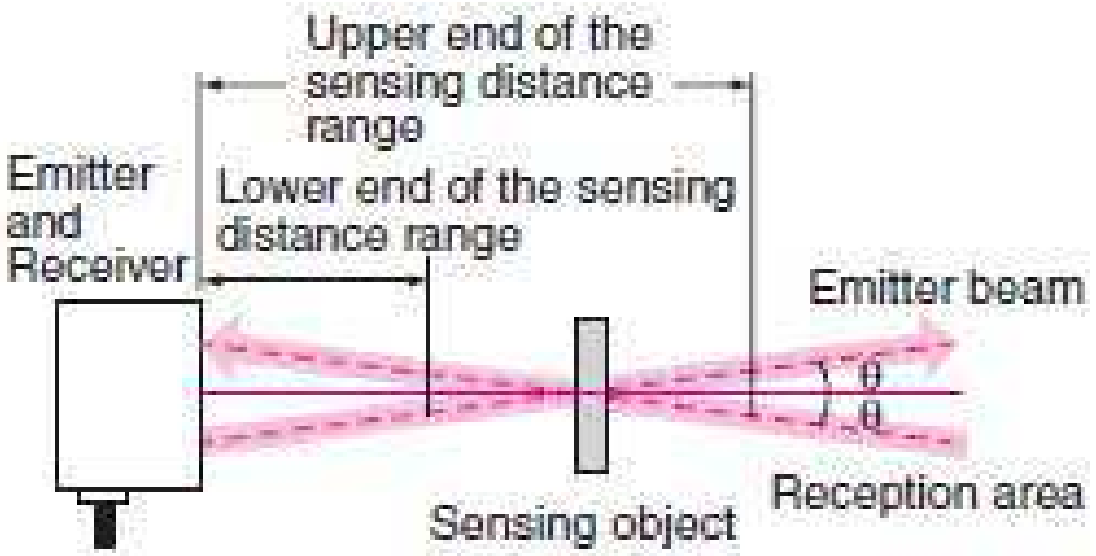
Kod ove vrste senzora može se podesiti opseg rastojanja u kome će objekat biti detektovan.

Senzor ograničene refleksije

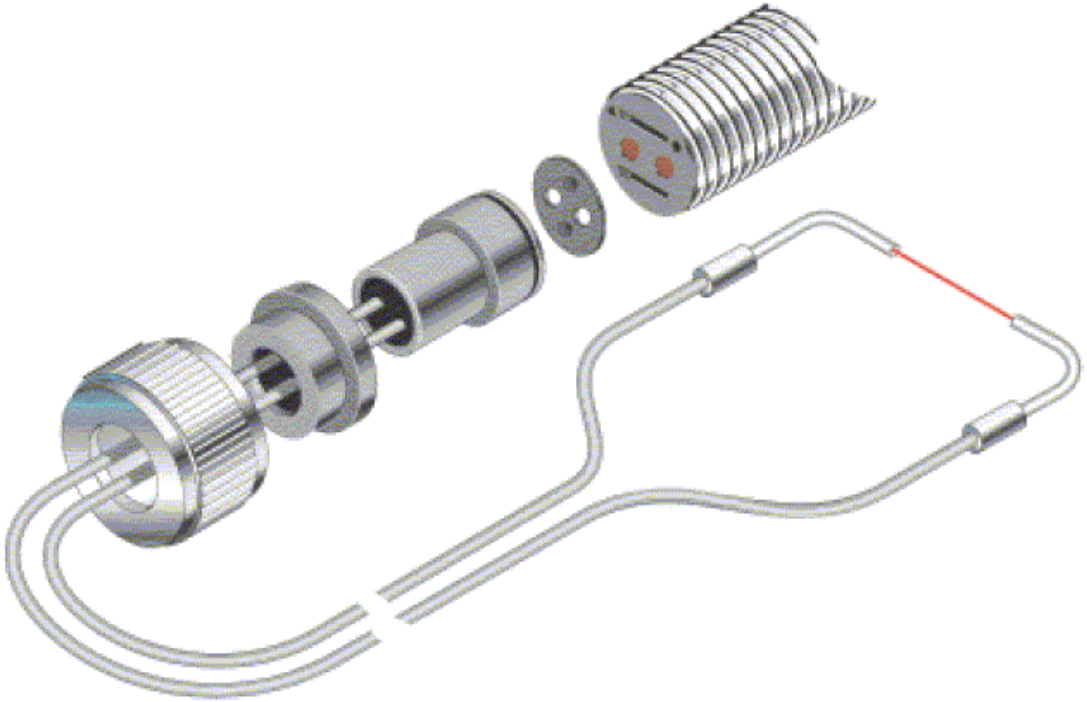


Slično kao difuzioni senzor, detektuje svjetlost reflektovanu od objekta. Međutim, uglovima je podešeno da detektuje objekte samo na jednom određenom rastojanju, ni bliže, ni dalje.

Senzor ograničene refleksije



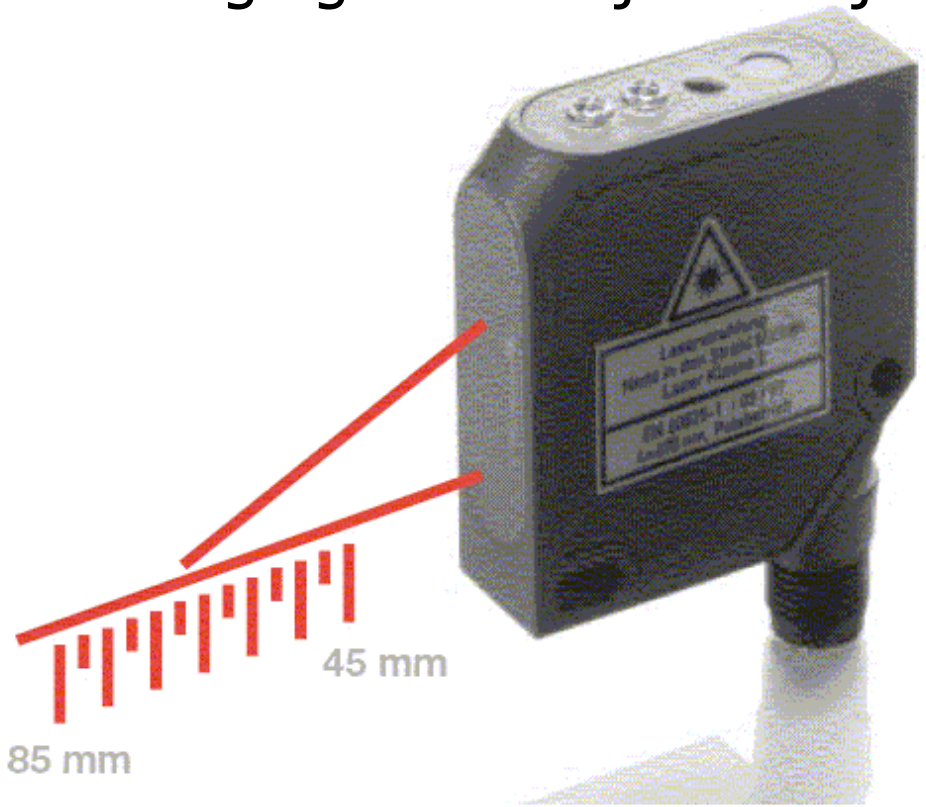
Davači sa optičkim vlaknima



Zahvaljujući optičkim vlaknima svjetlosna linija može da se postavi precizno i na teško dostupnim mjestima.

Laserski davač rastojanja

Predajnik emituje uski laserski zrak. Prijemnik (u vidu linijske kamere) vidi osvjetljenu tačku na objektu pod određenim uglom. Na osnovu tog ugla određuje se daljina objekta.



Izgled gotovih senzora

Reflex edge sensor

High performance
line/edge sensor

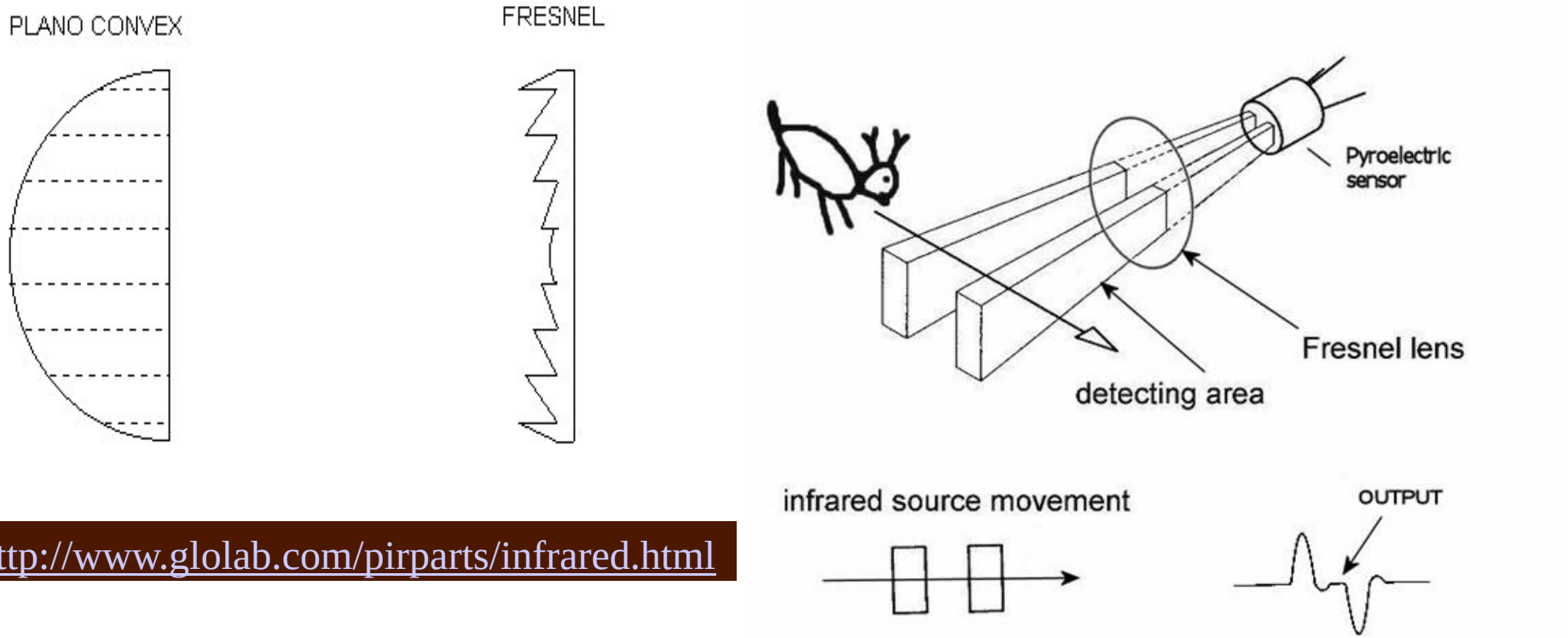
Low cost line/edge sensor

PIR detektori pokreta (za alarmne sisteme)

PIR senzor je osjetljiv na zračenje tijela čija je temperatura oko 37°C.
PIR= Passive Infa Red = pasivni infracrveni
Providni poklopac je napravljen kao više (Fresnelovih) sočiva kojima se dobija nejednaka osjetljivost senzora po raznim pravcima.
Rezultat je visoka osjetljivost na pokrete čovjeka ispred detektora.

http://en.wikipedia.org/wiki/Passive_infrared_sensor

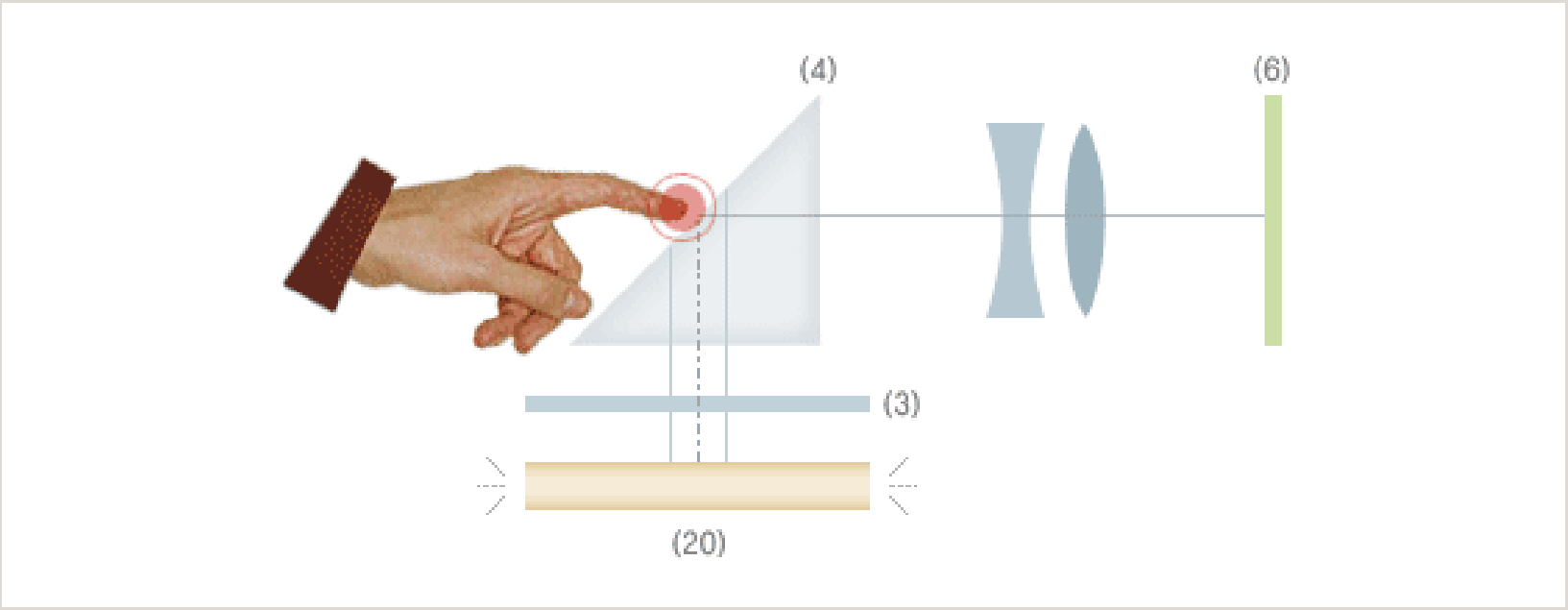
PIR detektori pokreta (za alarmne sisteme)



http://www.glolab.com/pirparts/infrared.html

Tijelo se kreće i presjeca zone različite osjetljivosti senzora.
Na senzoru se dobija promjenljivi napon koji se lako razlikuje od napona usled promjene osvjetljenja ili promjene temperature okoline.

Optički skener otiska prsta



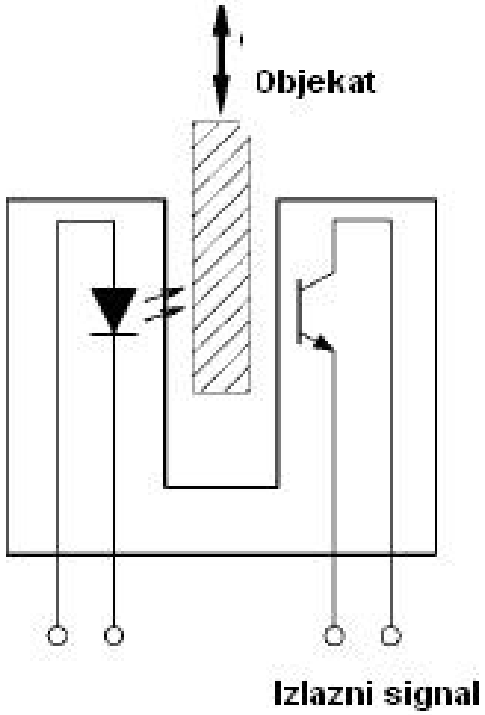
Sistem sočiva kod optičkih fingerprint senzora

Prst se prisloni na pločicu, osvijetli sa LED izvorom svjetlosti i kroz prizmu i sistem sočiva slika se projektuje na kameru.

Primjene skenera otiska prsta

Koristi se za ovlašćeni pristup:
- prostorijama,
- podacima,
- računaru ili
- nekom drugom sadržaju (na primjer tašni).

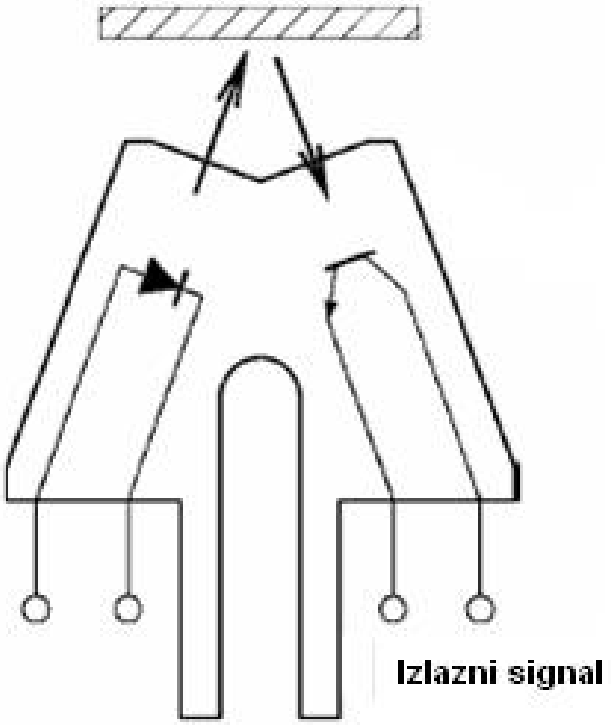
Optička viljuška je prolazni senzor

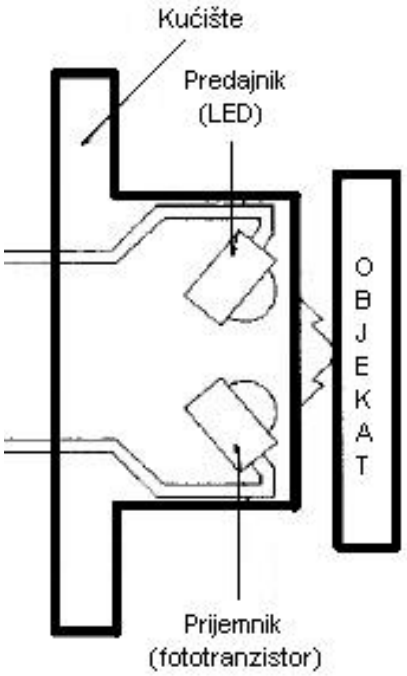


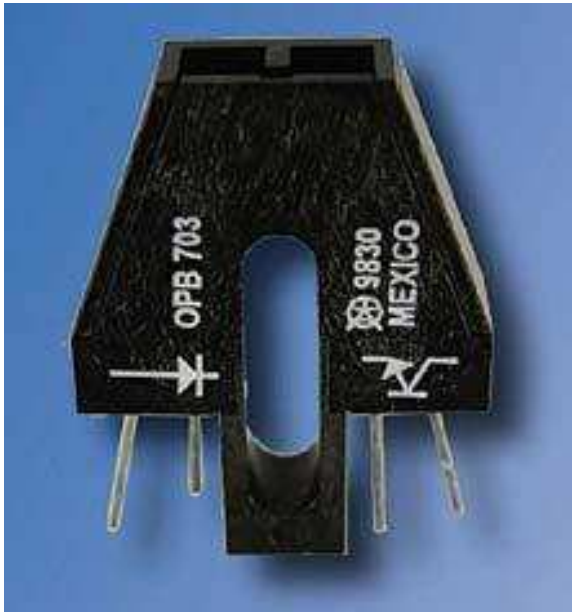
Princip rada optičke viljuške i njezin izgled

Dimenzije viljuške su oko 1cm.

Blizinski difuzioni davači



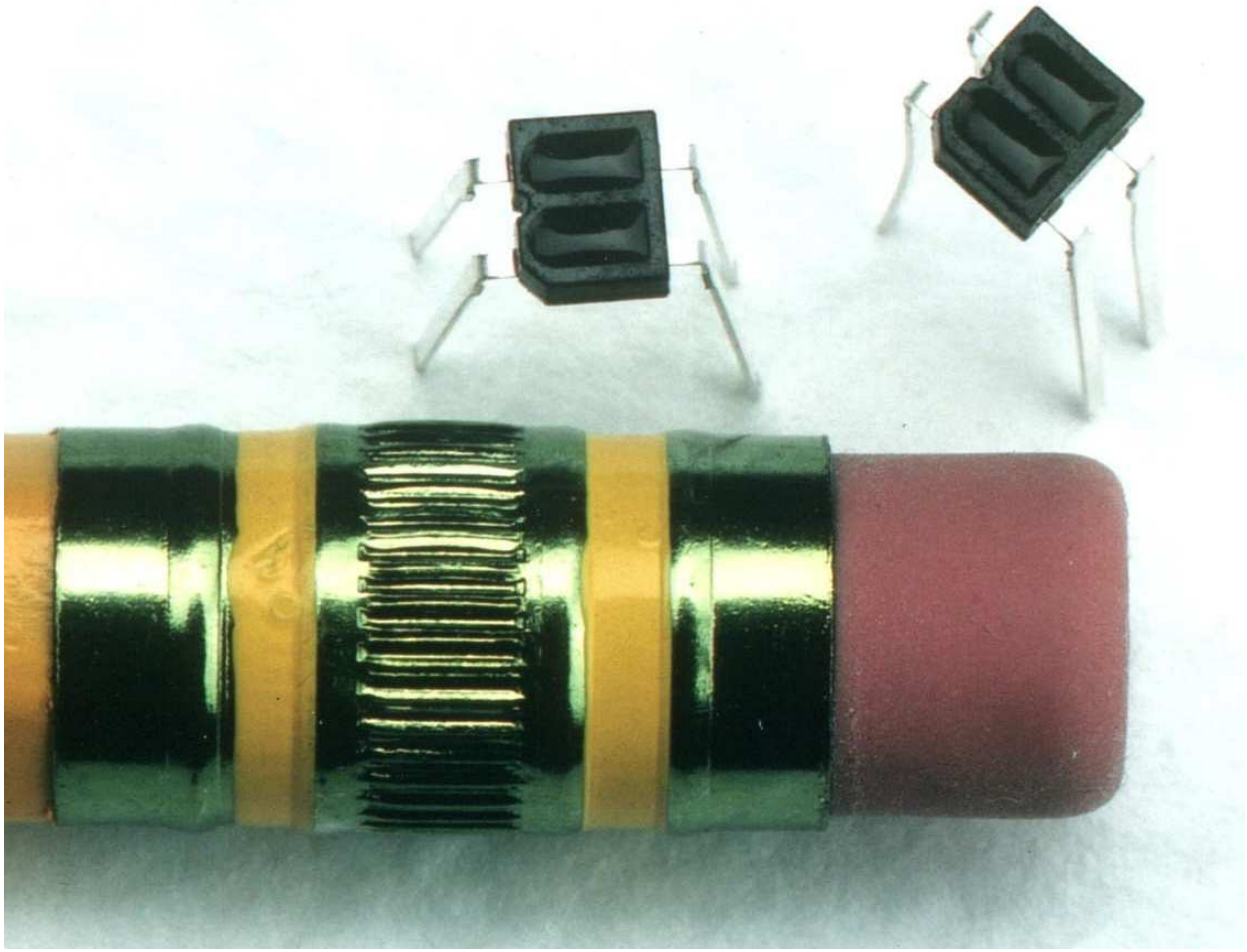




Princip rada blizinskog difuzionog davača i njegov izgled

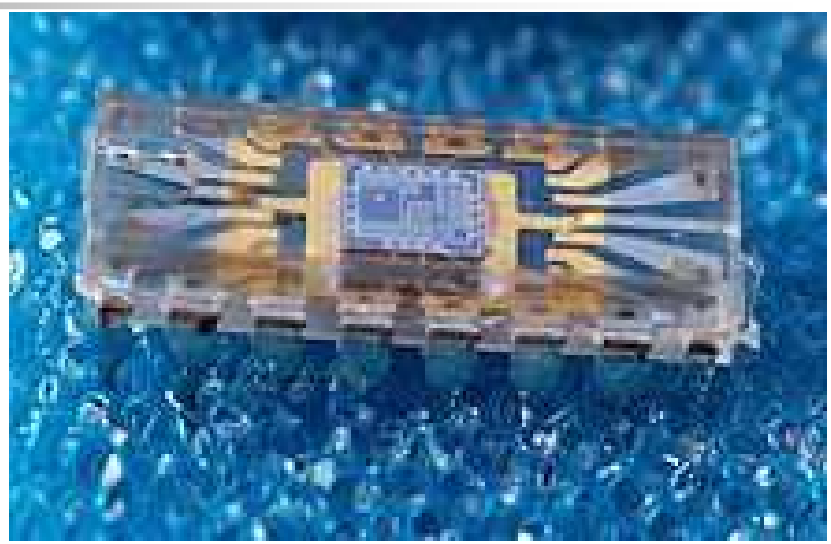
Dimenzije davača su oko 1cm.

Veličina blizinskog senzora



Optički miš

http://en.wikipedia.org/wiki/Optical_mouse#Optical_mice



optički čip

Optički miš se sastoji od:
- LED (ili lasera) za osvjetljavanje podloge,
- minijaturne kamere sa optičkim čipom male rezolucije (18x18 piksela)
- čipa za obradu slike i komunikacije sa PC-om.

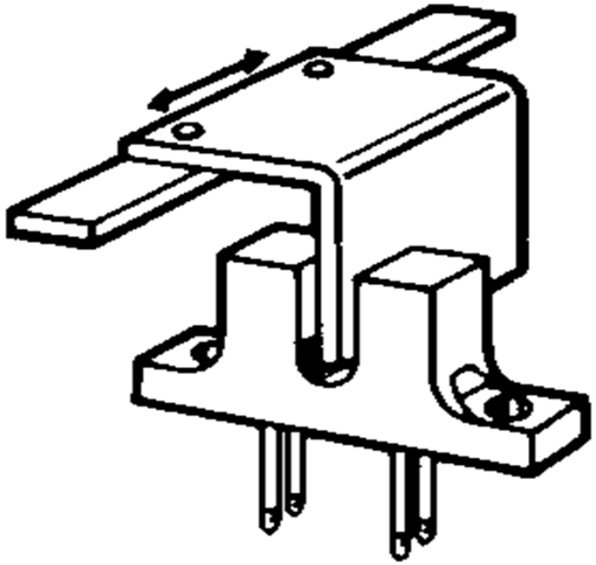
Optički miš se može pretvoriti u skener. Više detalja ima na

http://spritesmods.com/?art=mouseeye

Primjena optičkih davača

Detektovanje pokretne neprozirne zastavice

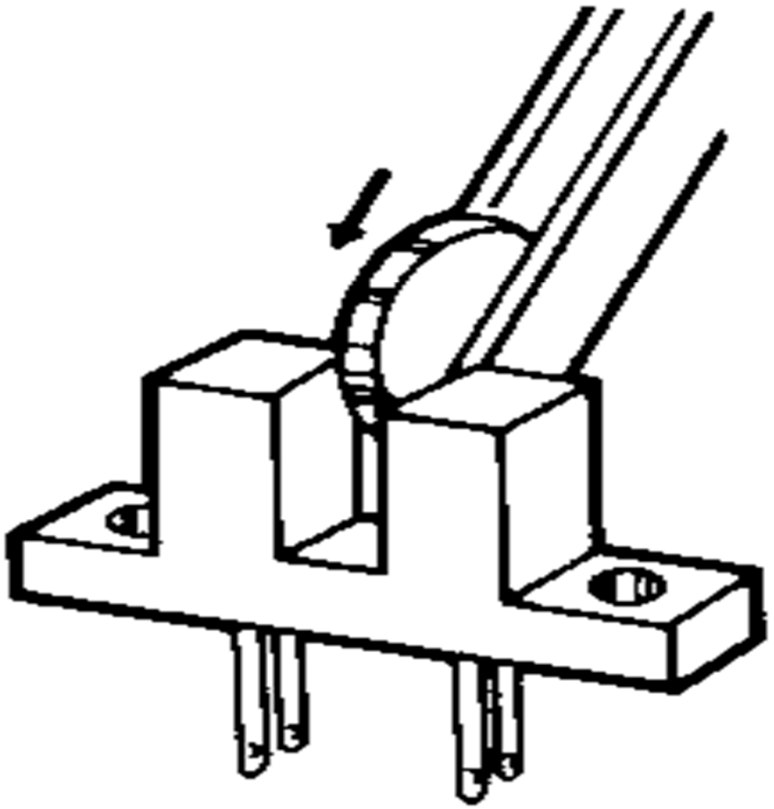
1. Sensing of moving sheet metal



Obično služi kao detektor krajnjeg položaja mehanizma (u štampačima, ploterima, i raznim drugim uređajima).

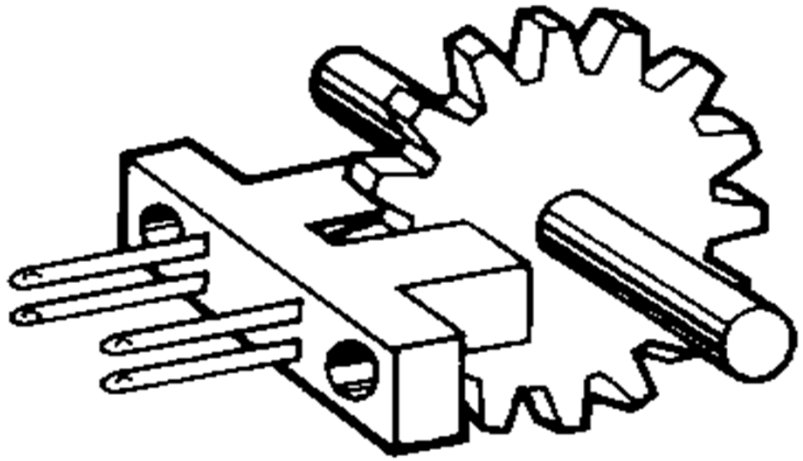
Detektovanje kovanog novca i metalnih komada

2. Sensing of coin and metal



Detektovanje zubaca kod prenosnih mehanizama

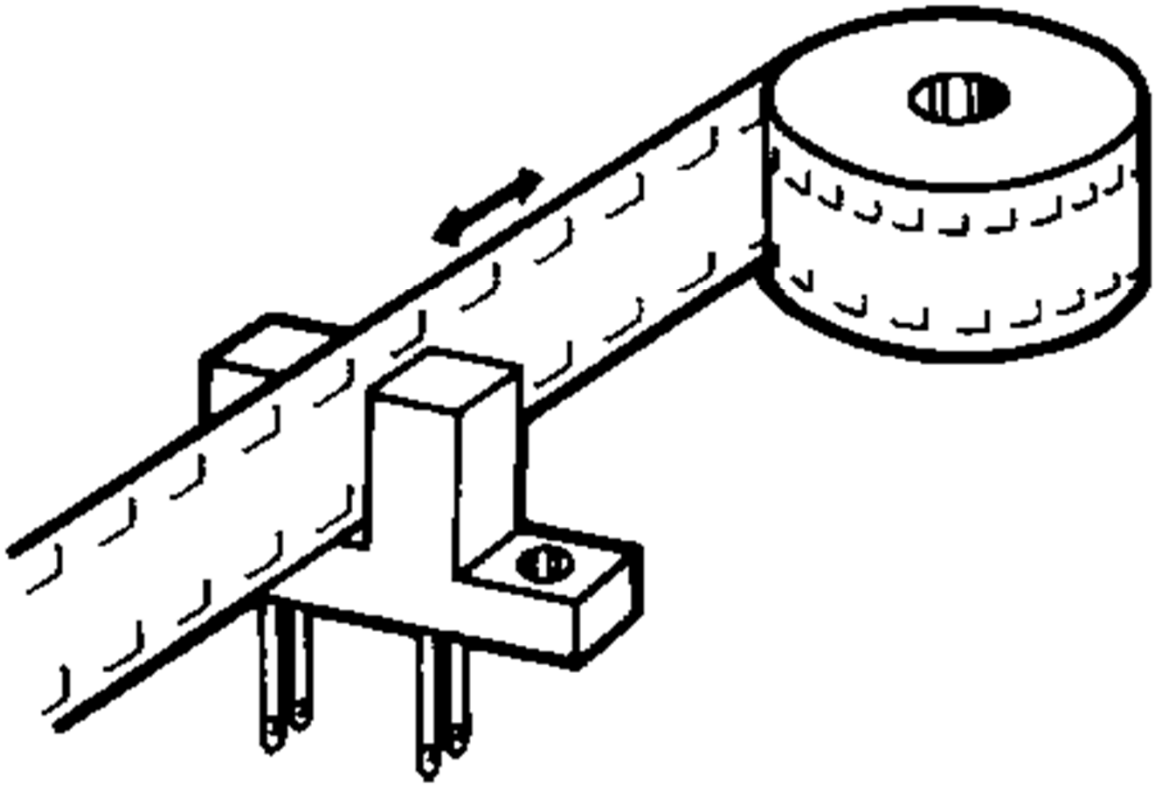
3. Sensing of gear tooth



Okretanjem zupčanika dobijaju se impulsi na fotoprijemniku. Broj impulsa u sekundi je mjera brzine obrtanja zupčanika.

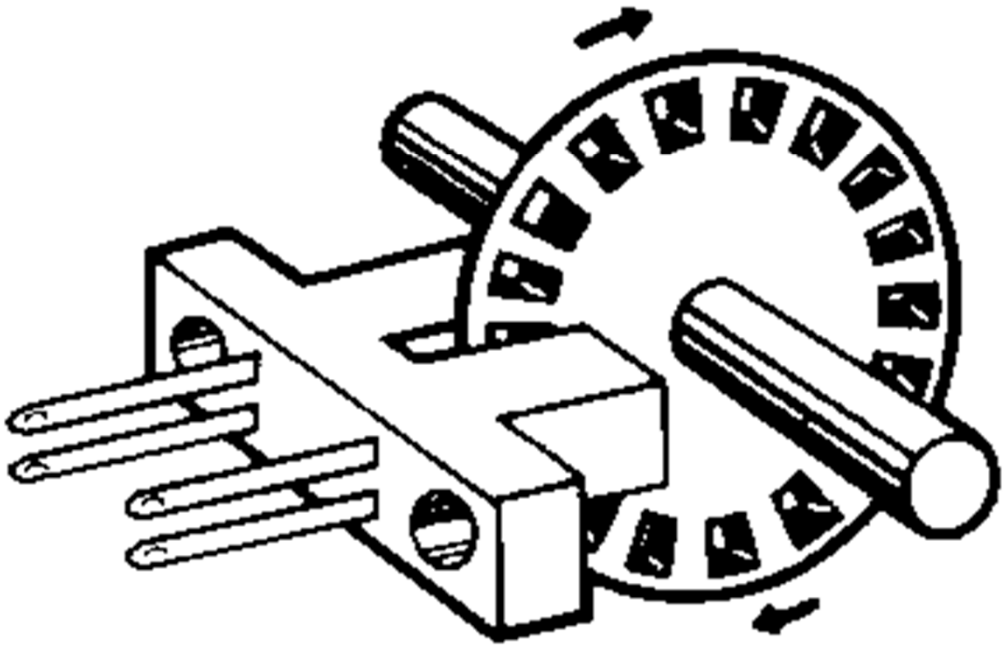
Detektovanje položaja filma

5. Sensing of film position



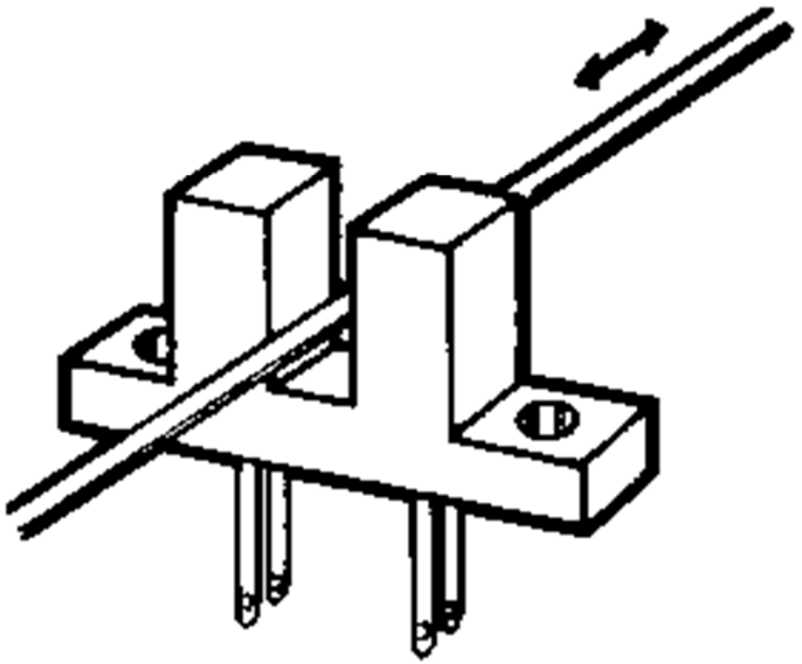
Detektovanje broja okretaja

6. Sensing of the number of revolutions



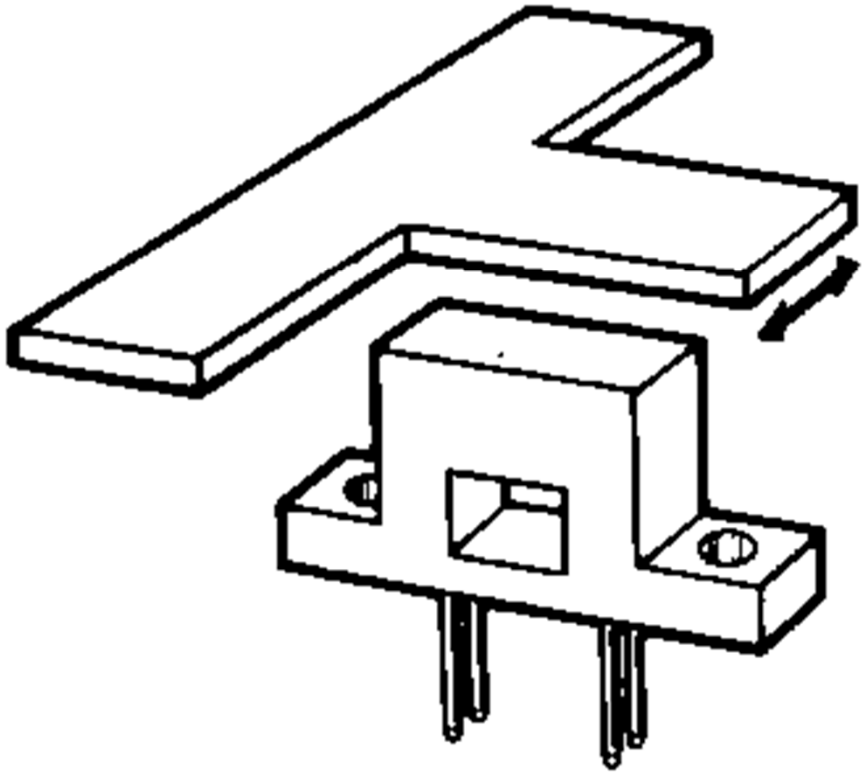
Detektovanje prekida žice

7. Sensing of a break in a wire



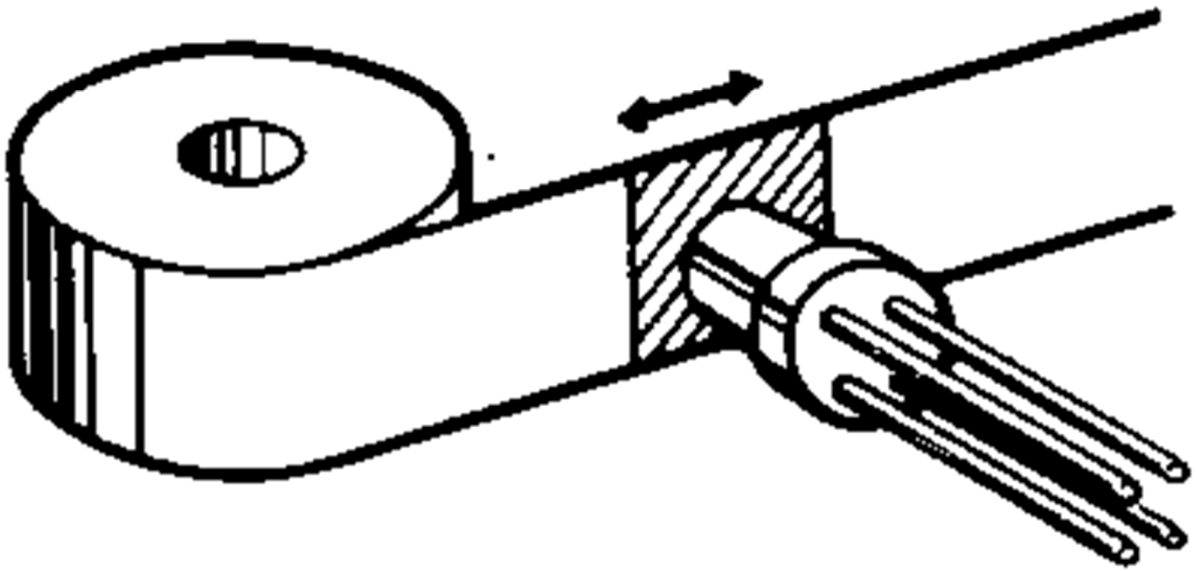
Detektovanje sjajne zastavice

1. Sensing of glossy sheet metal



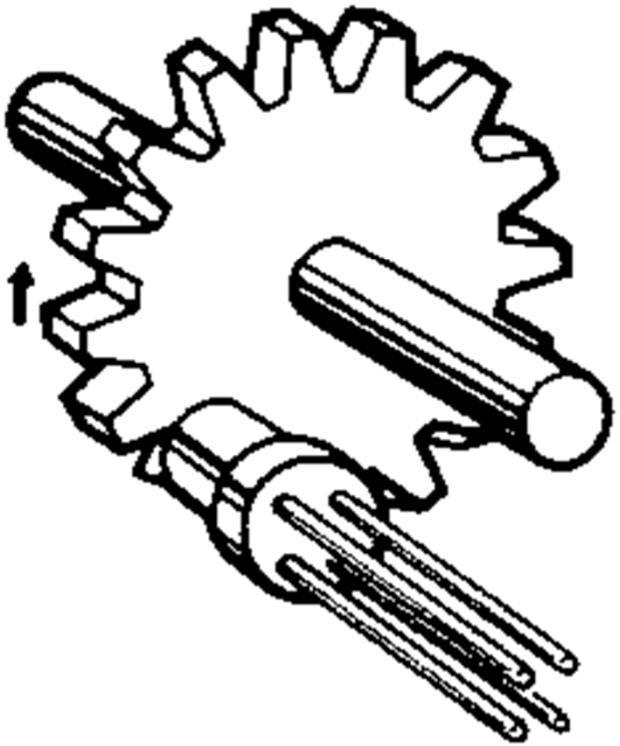
Detektovanje kraja ili početka trake

2. Sensing of the end or beginning of tape

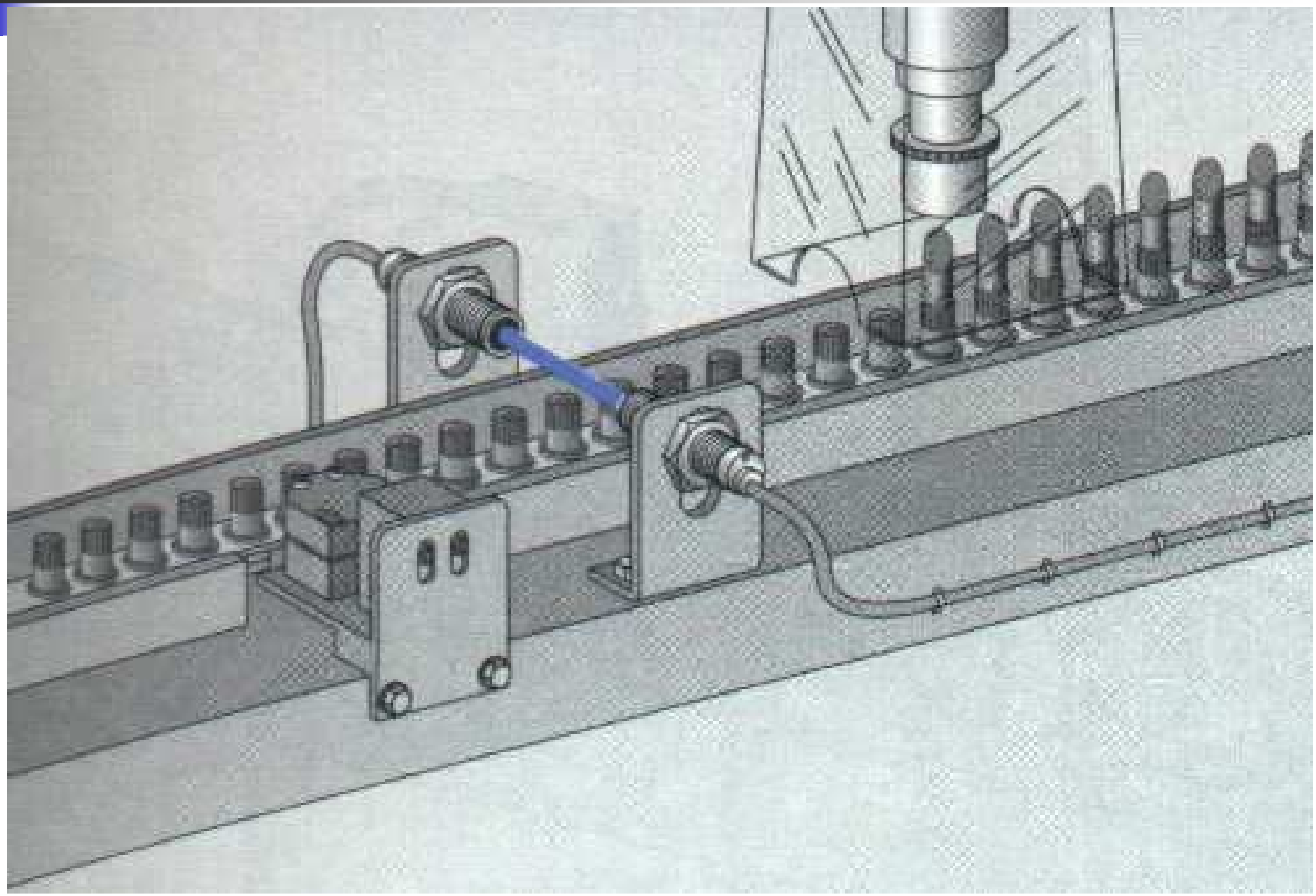


Detektovanje sjajnih zubaca

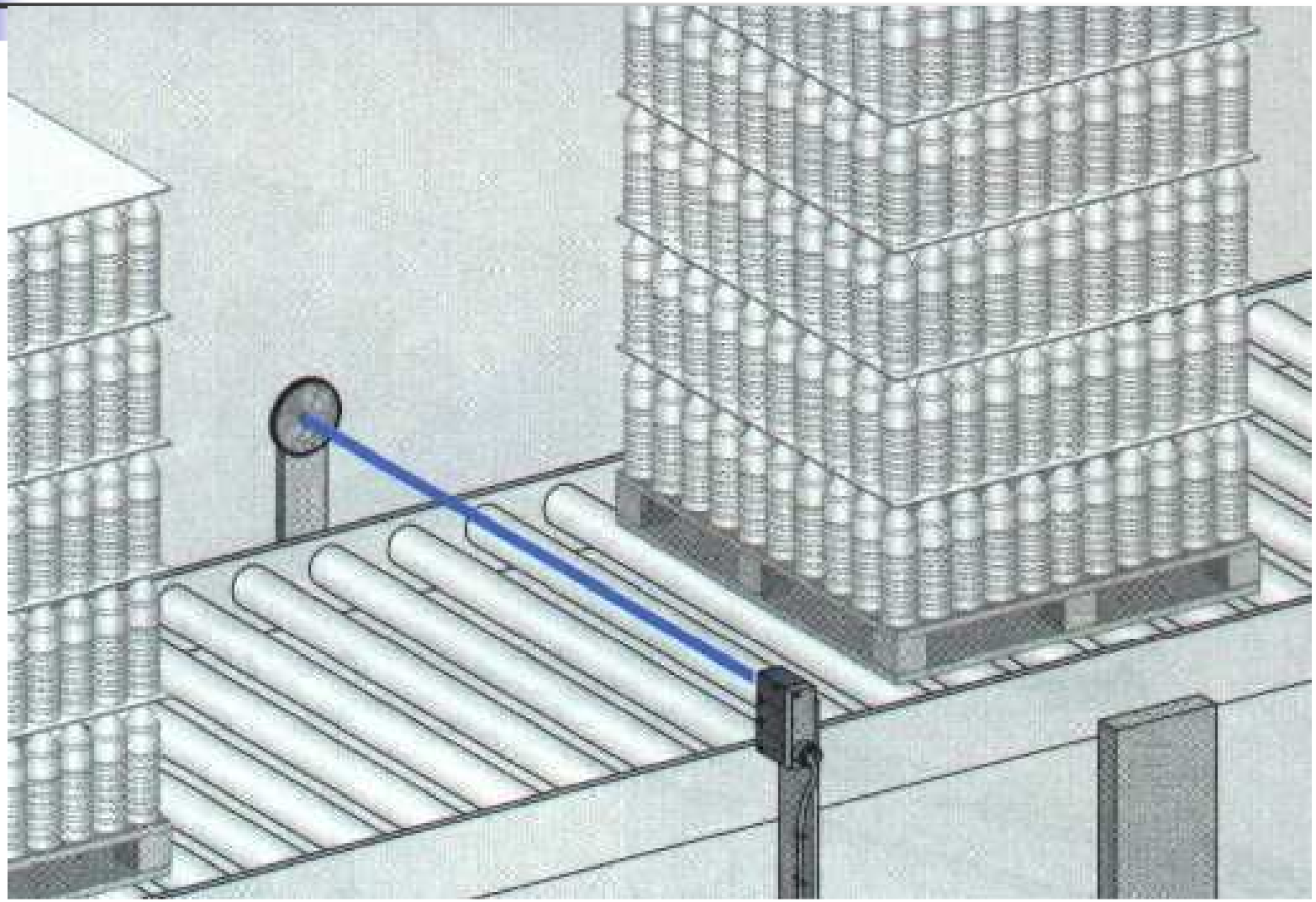
3. Sensing of glossy gear tooth



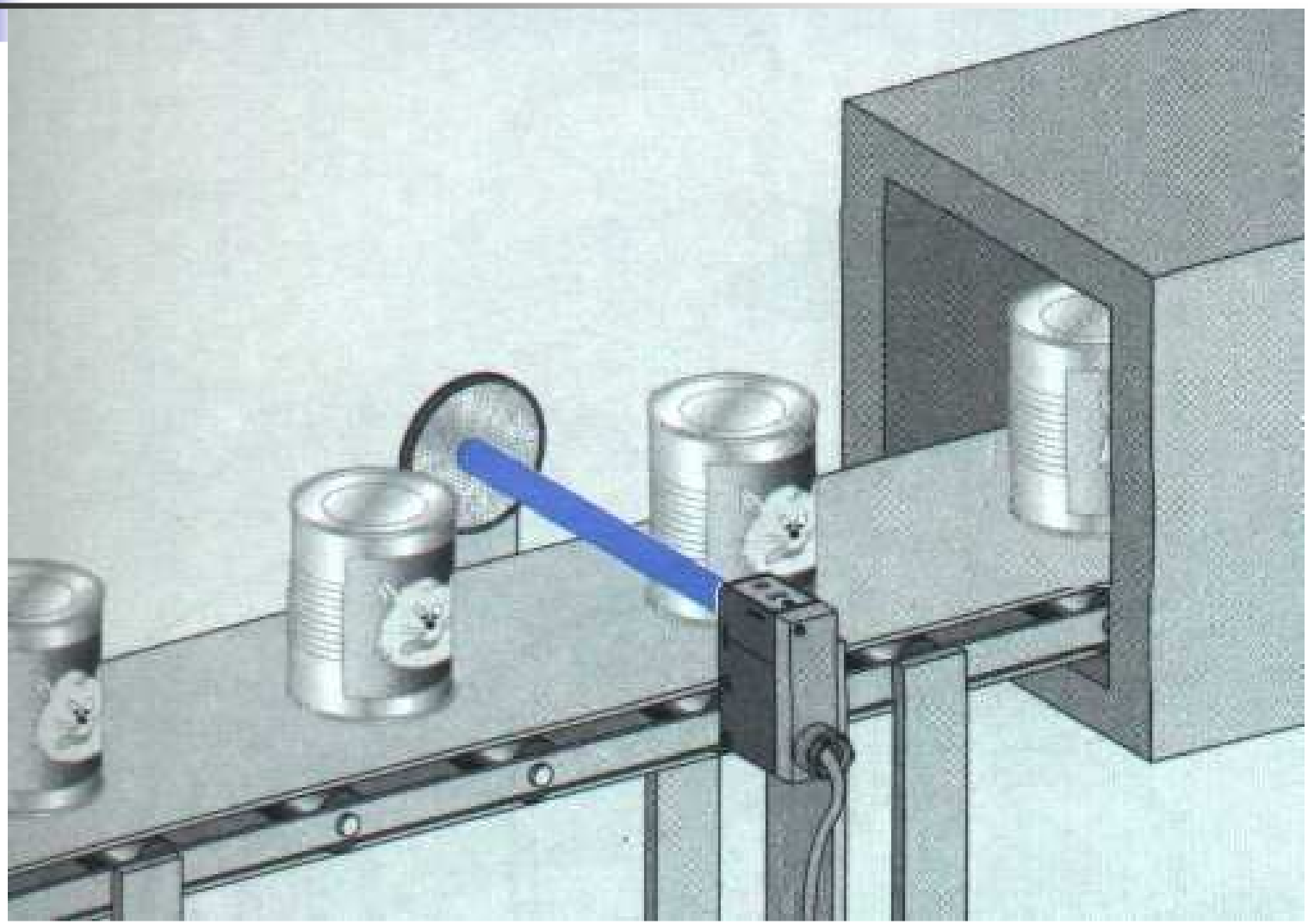
Kontrola visine karmina prije postavaljanja poklopca



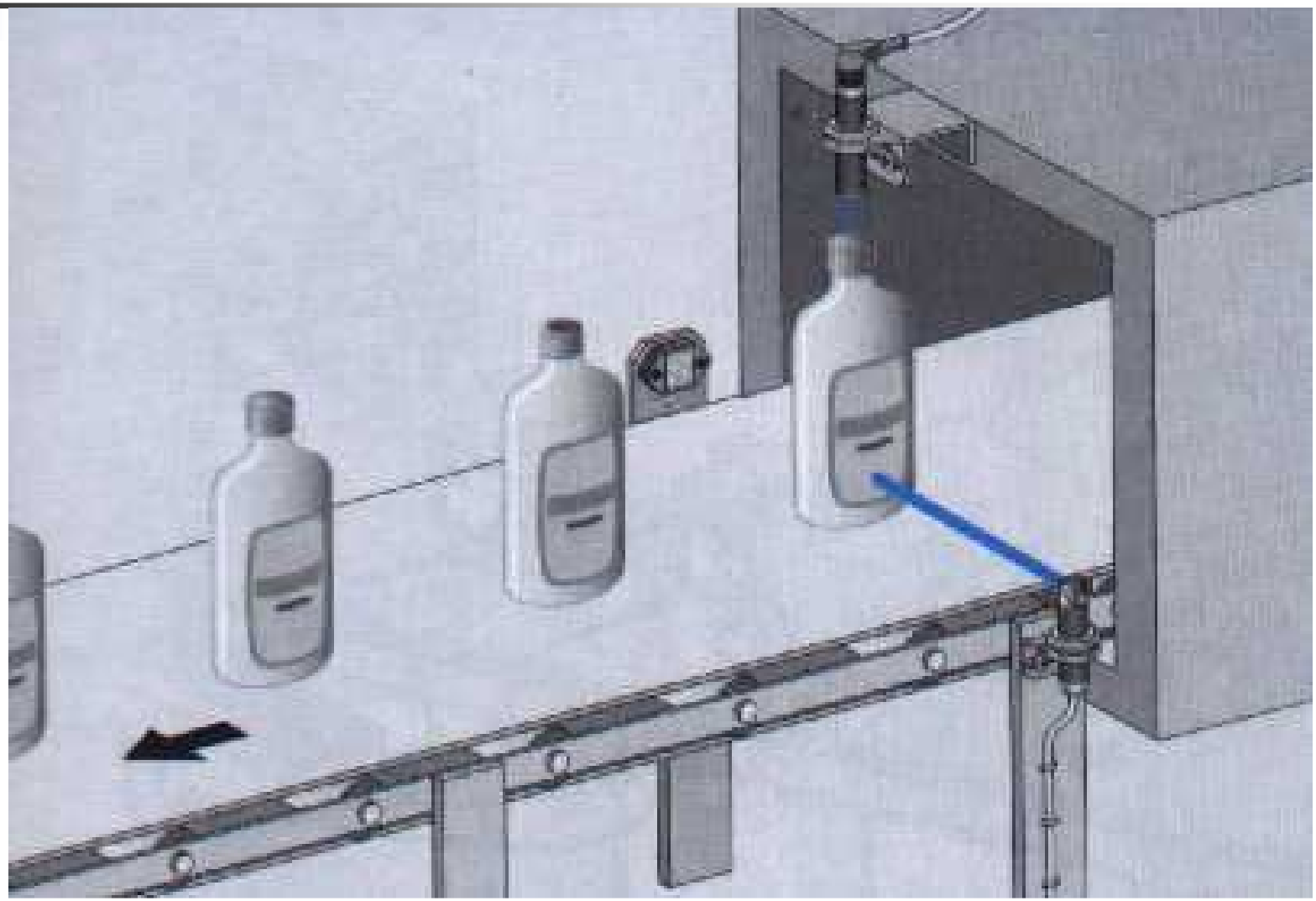
Kontrola prolaska paleta sa flaširanom vodom



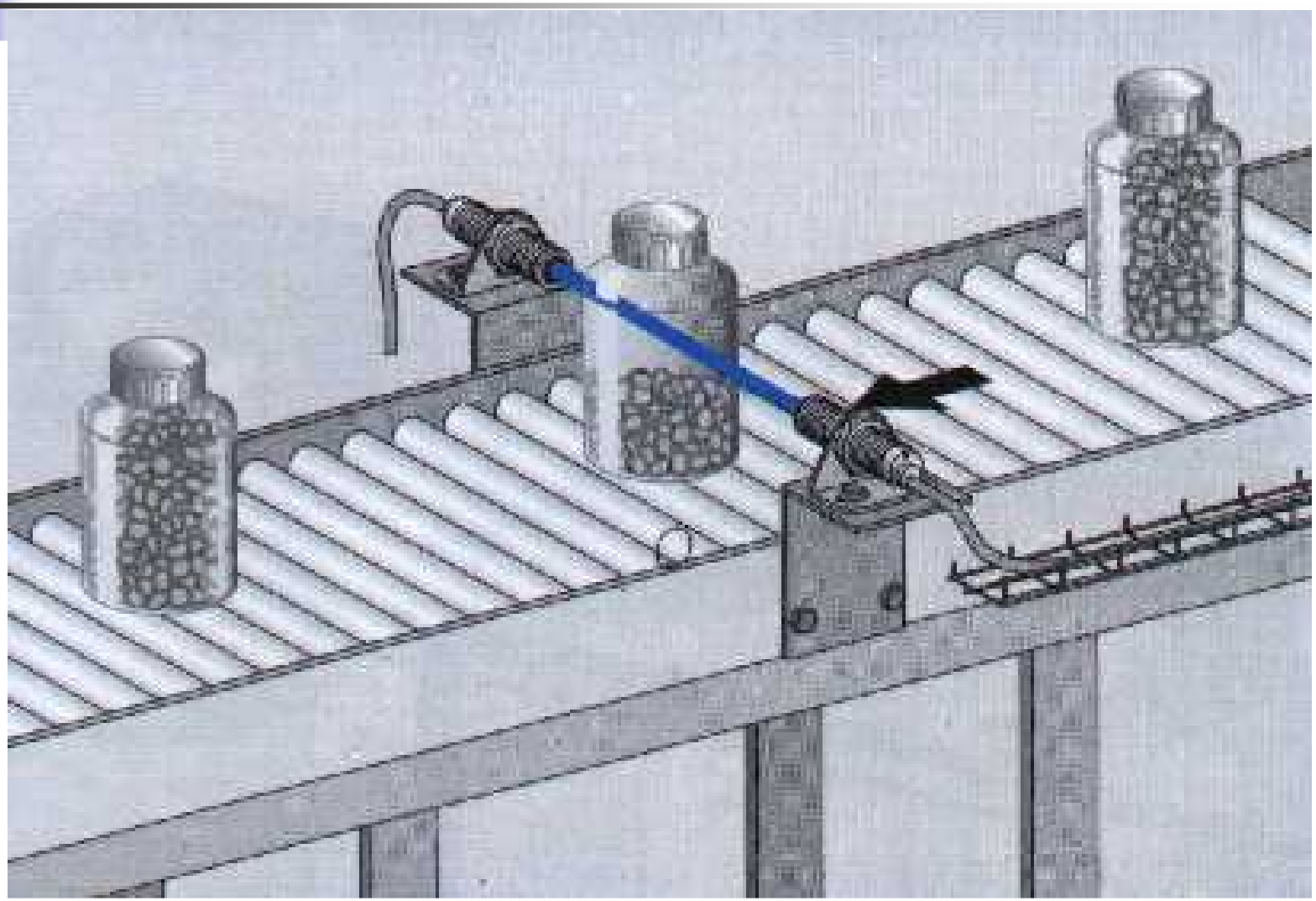
Kontrola prolaska konzervi (sa hranom za mačke)



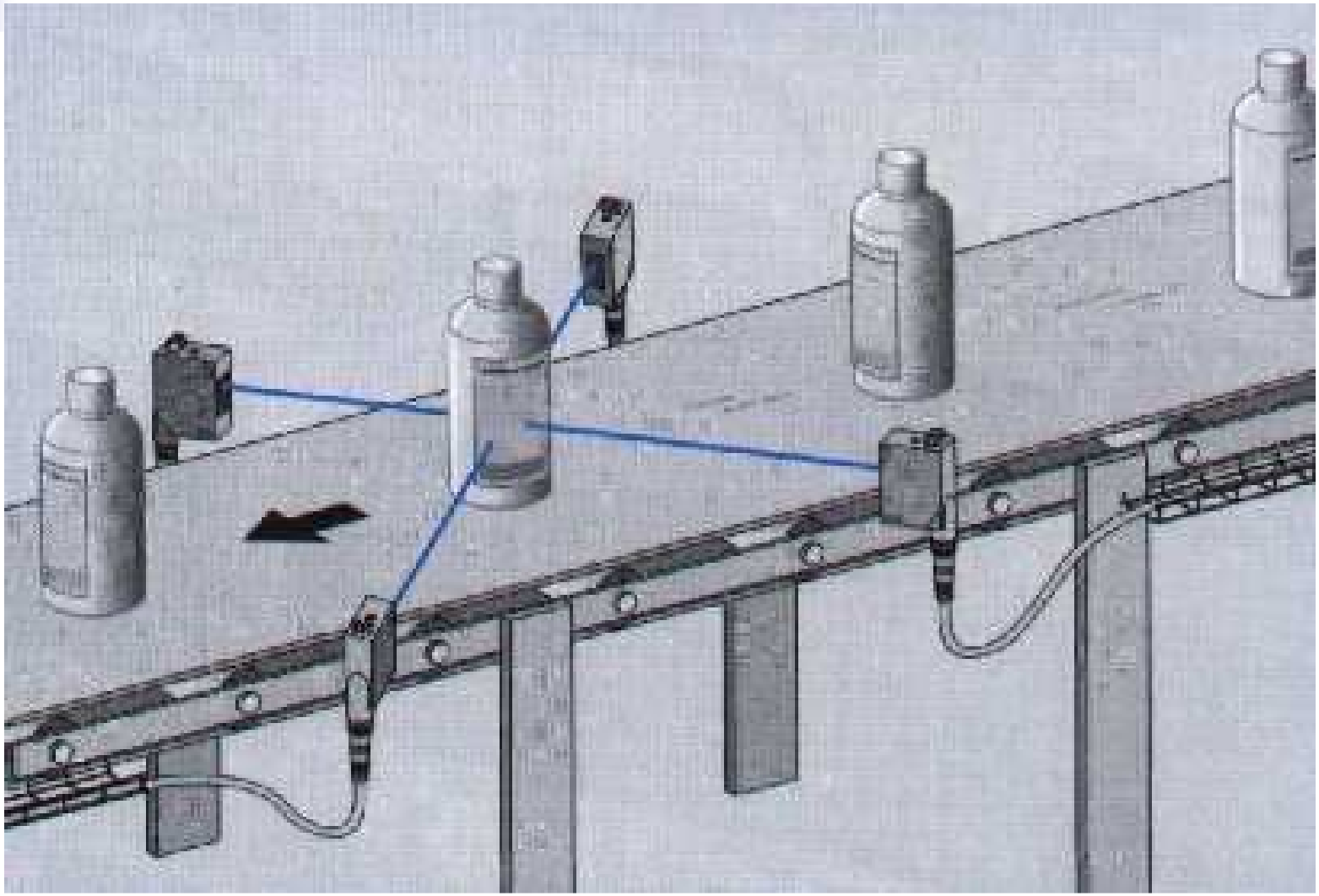
Provjera prisustva plastičnog čepa



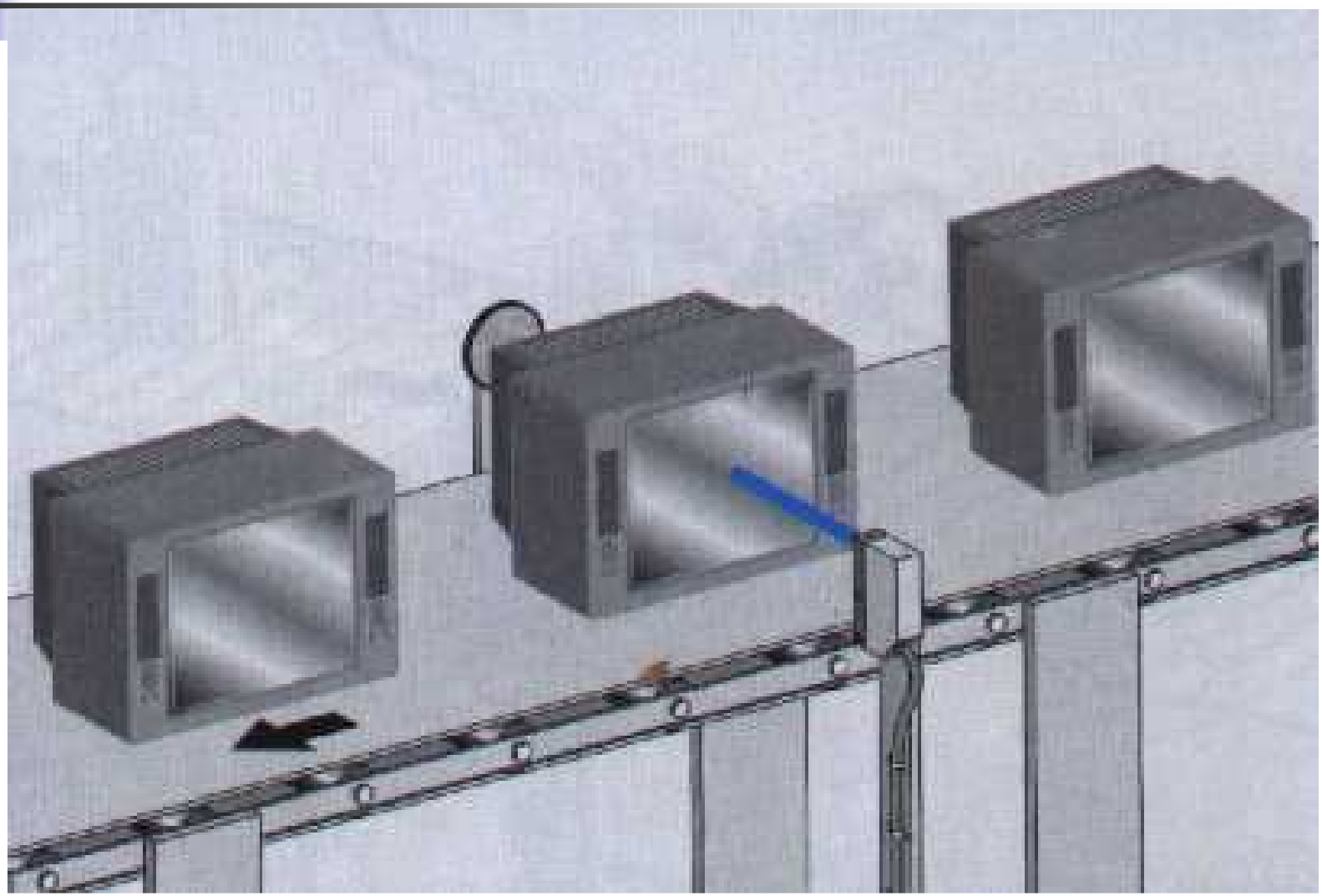
Kontrola tableta u bočicama



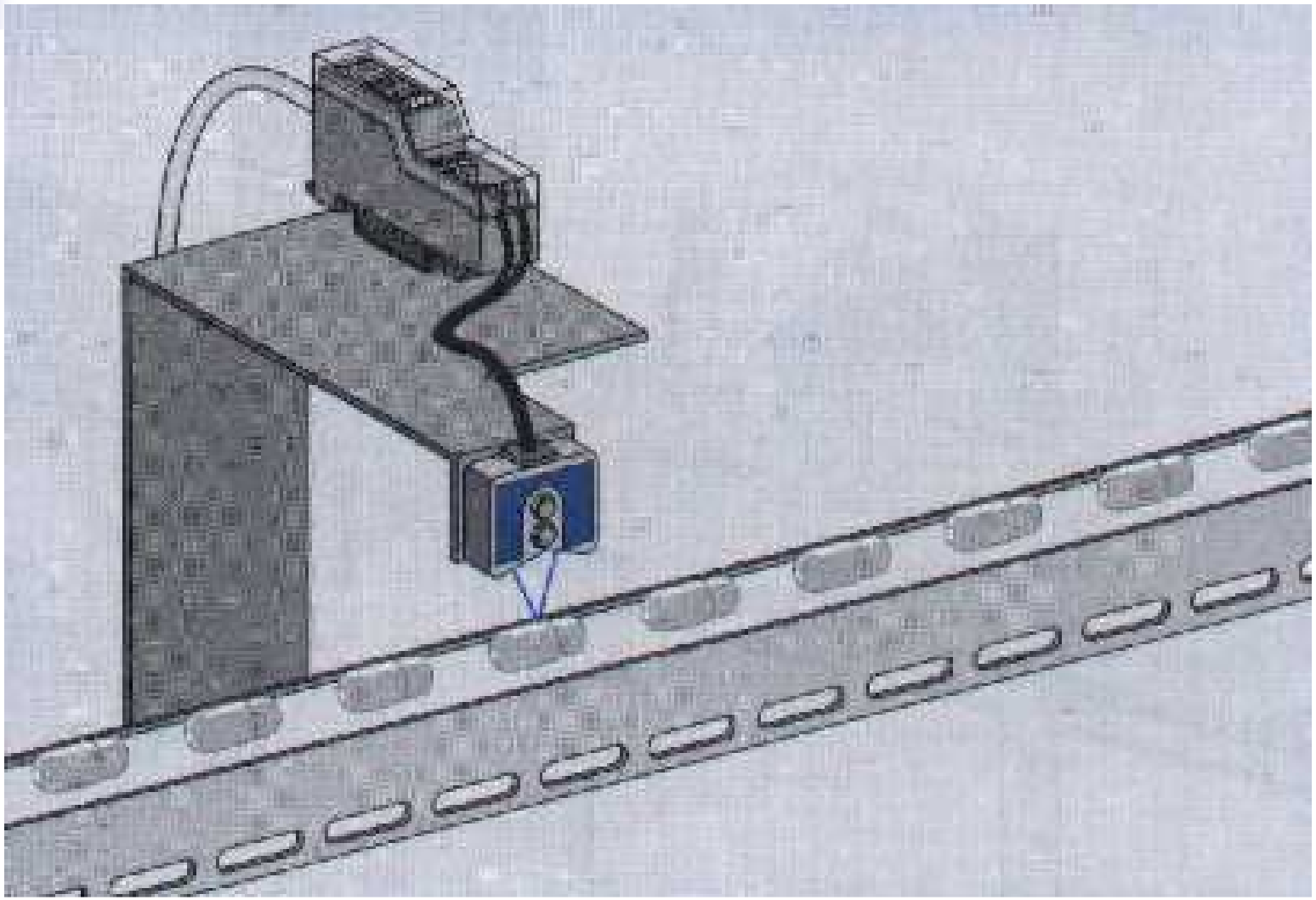
Kontrola naljepnica na bočicama



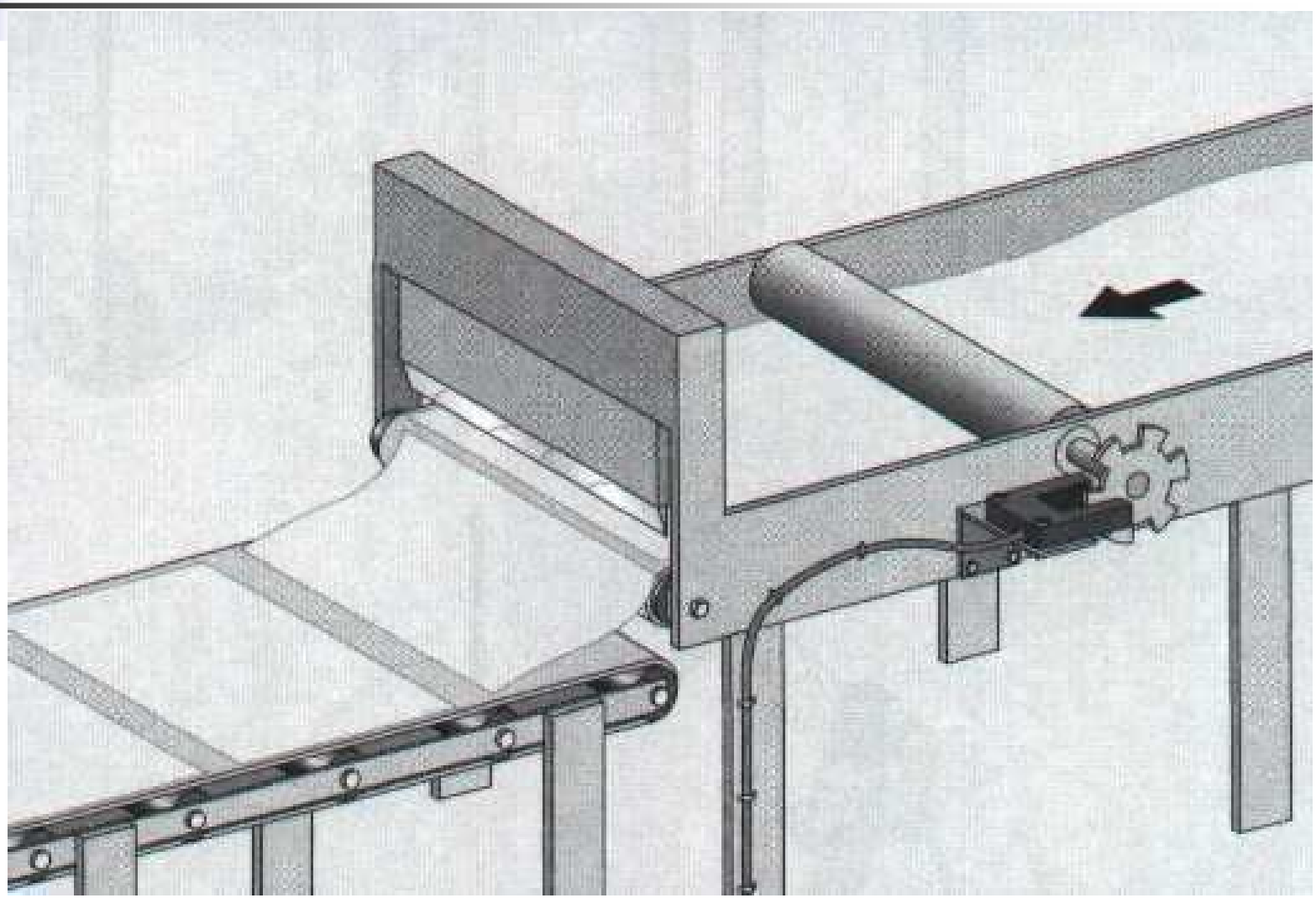
Brojanje televizora



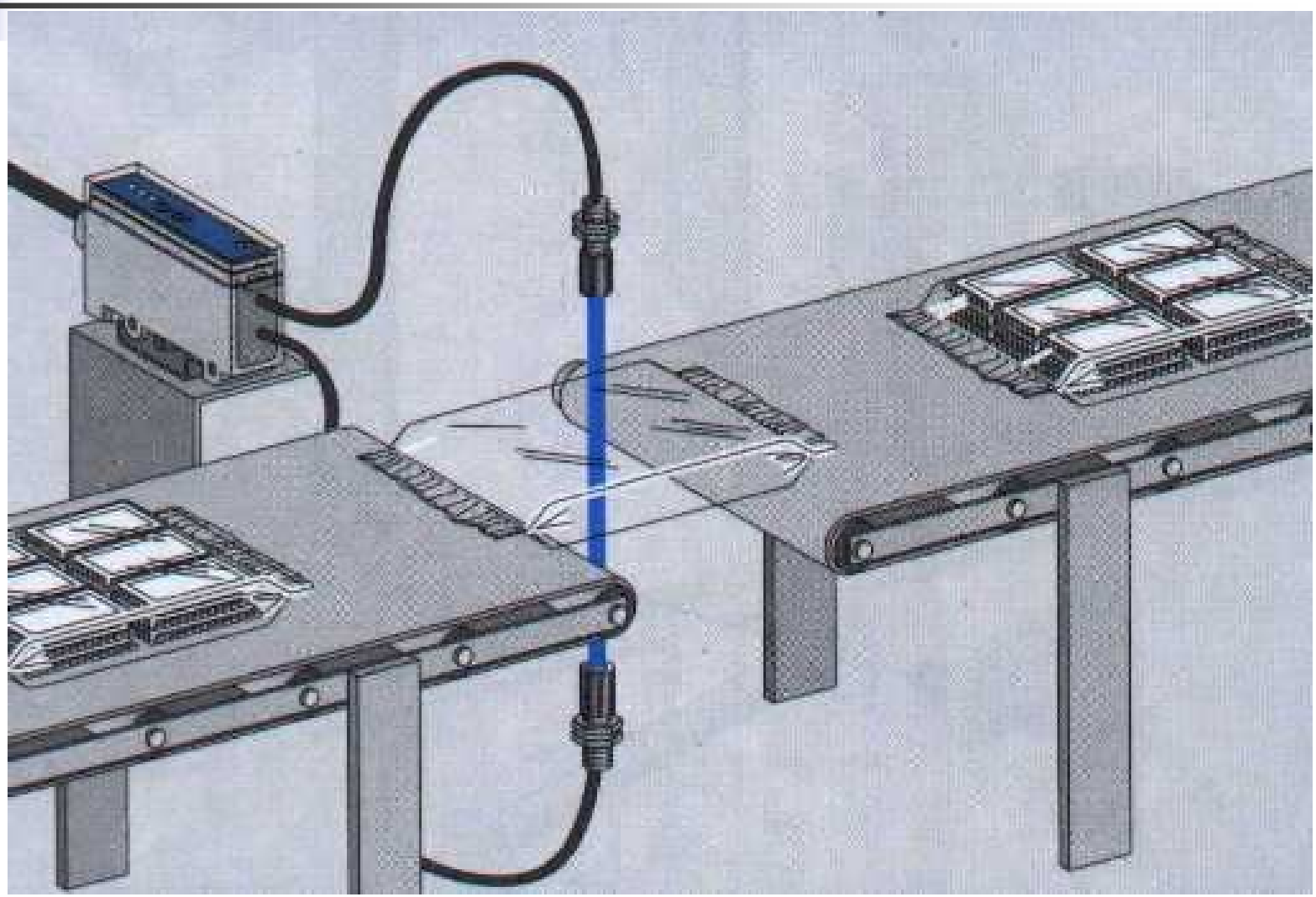
Brojanje tableta



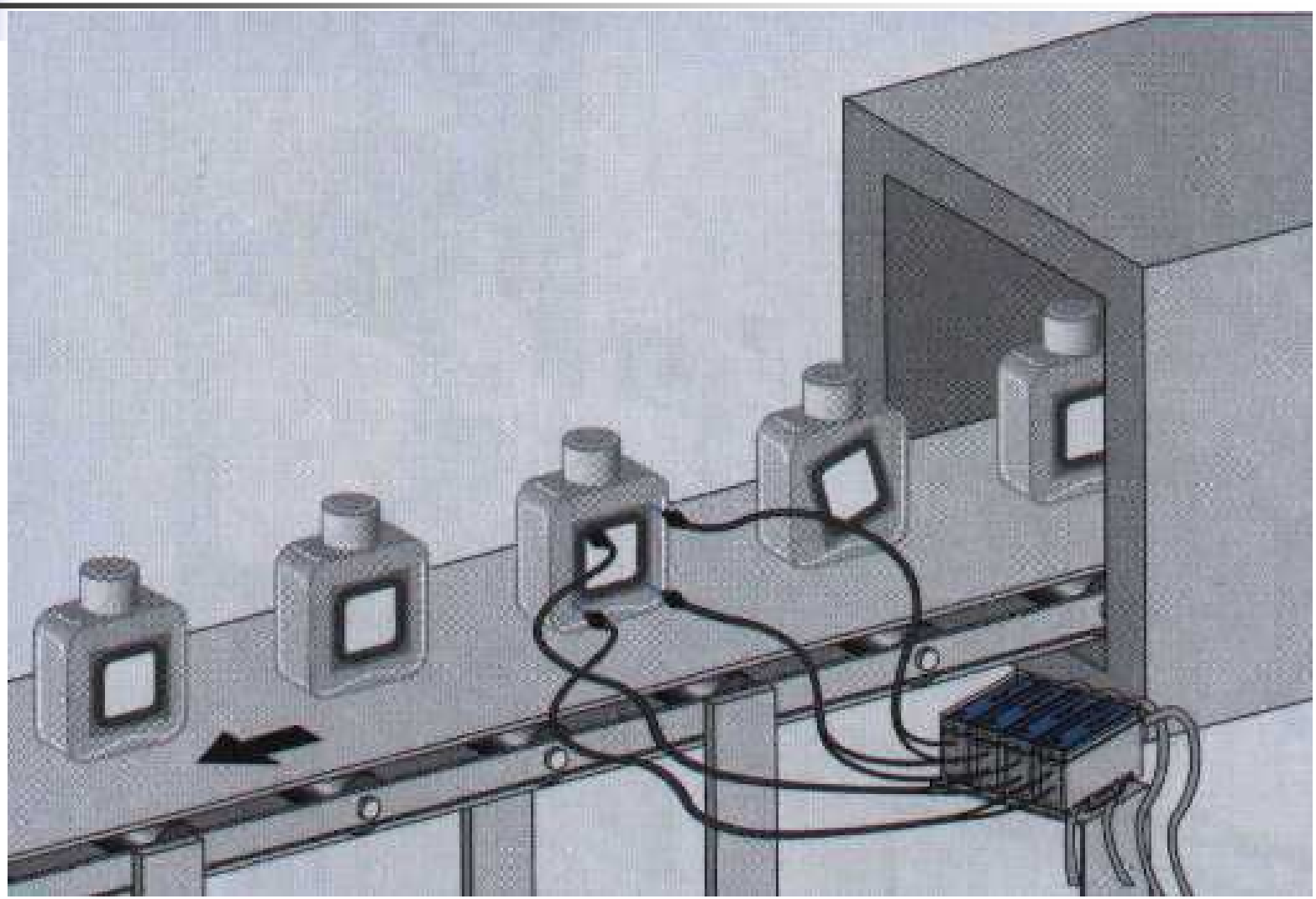
Sinhronizacija rezanja na zadatu dužinu



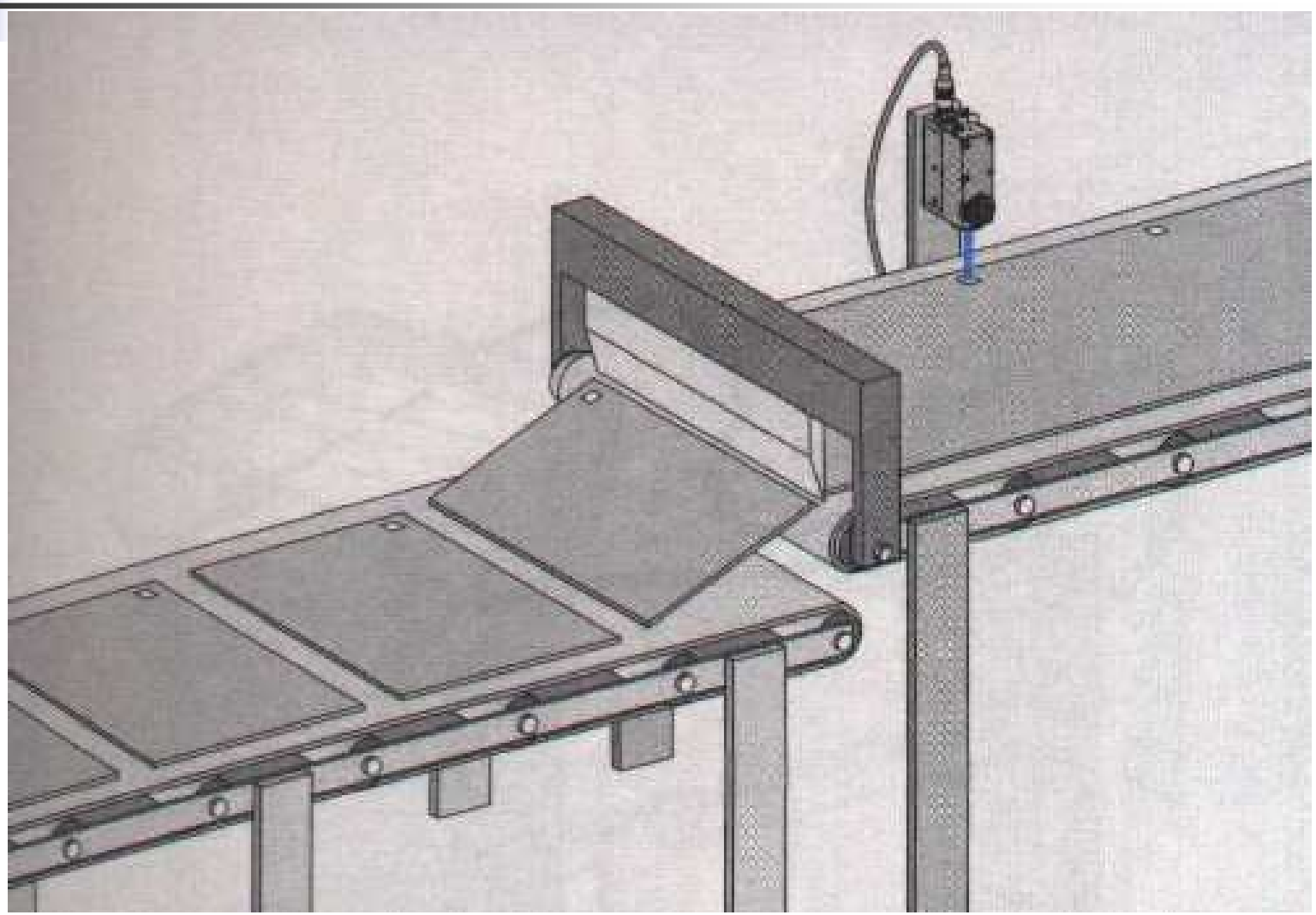
Otkrivanje praznog pakovanja



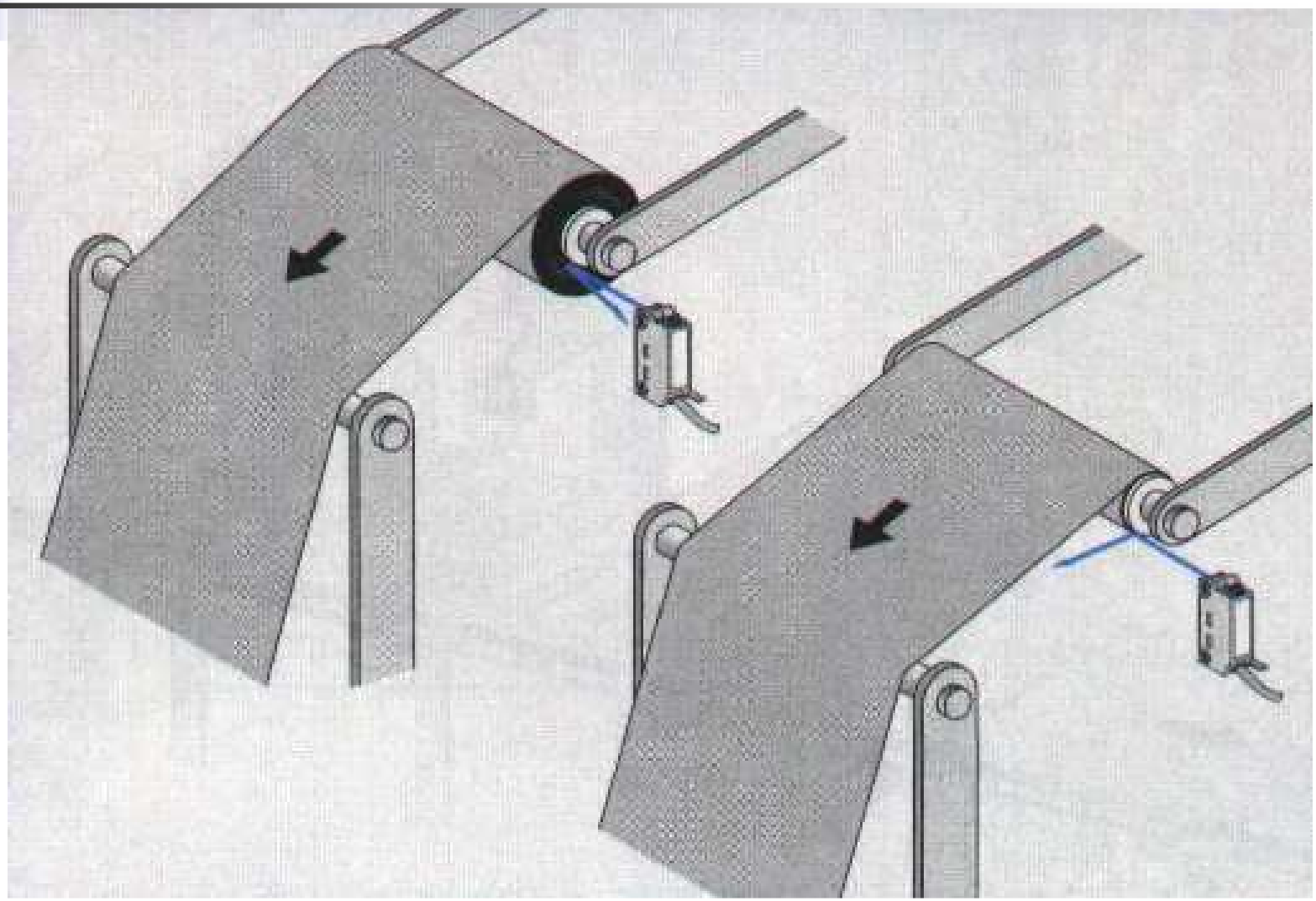
Otkrivanje neispravnog položaja etikete



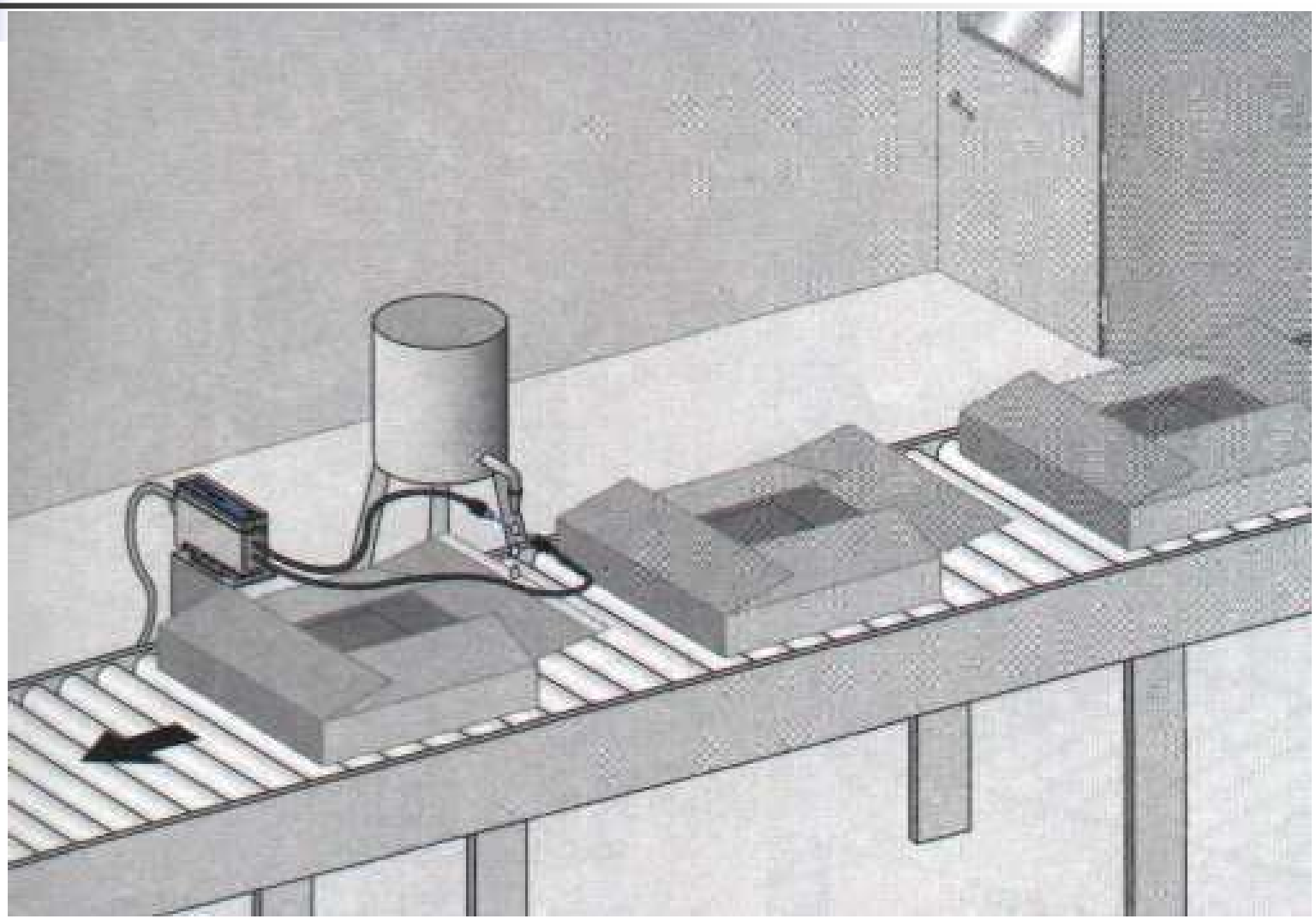
Očitavanje referentne oznake radi rezanja na mjeru



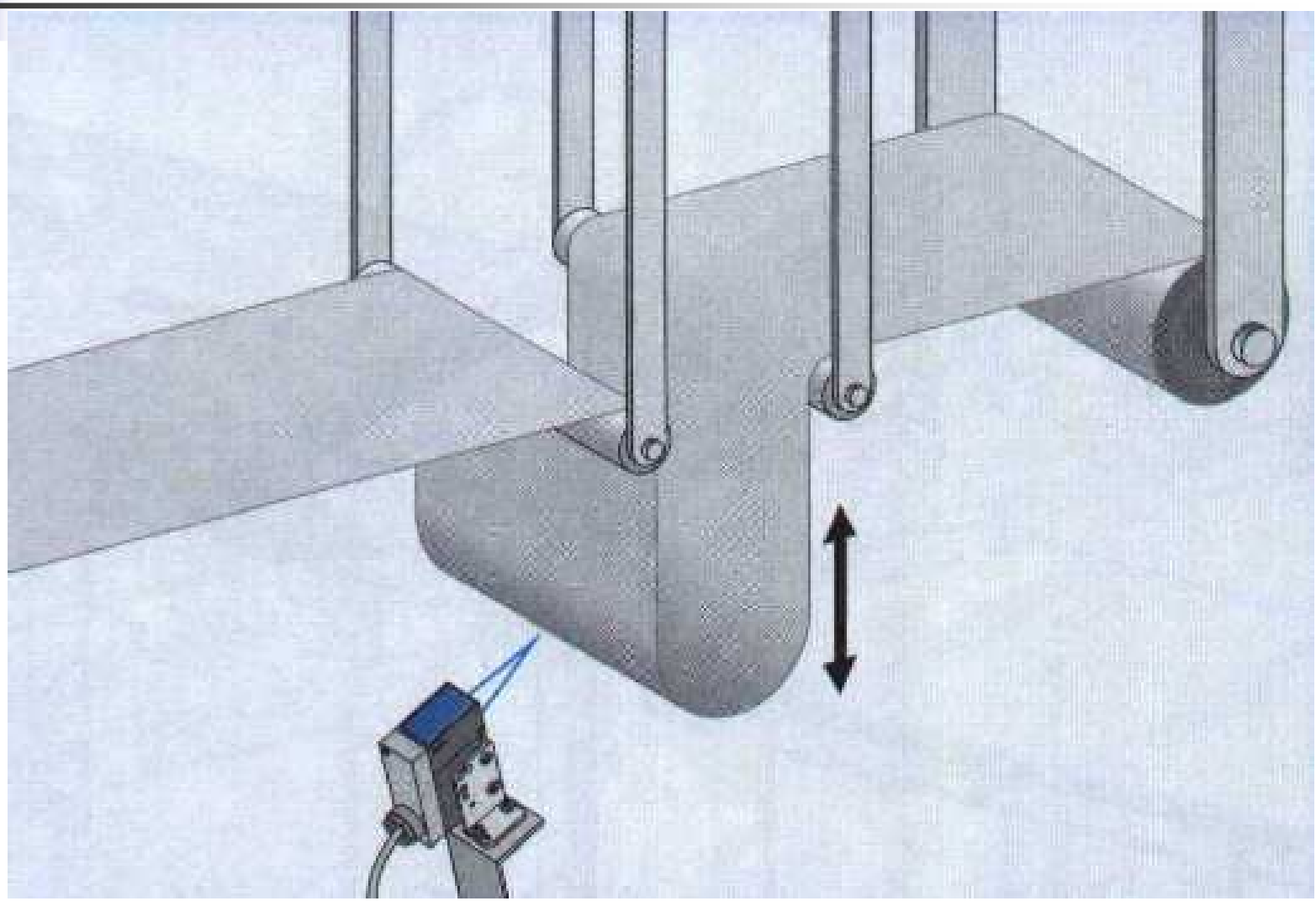
Detekcija kraja rolne



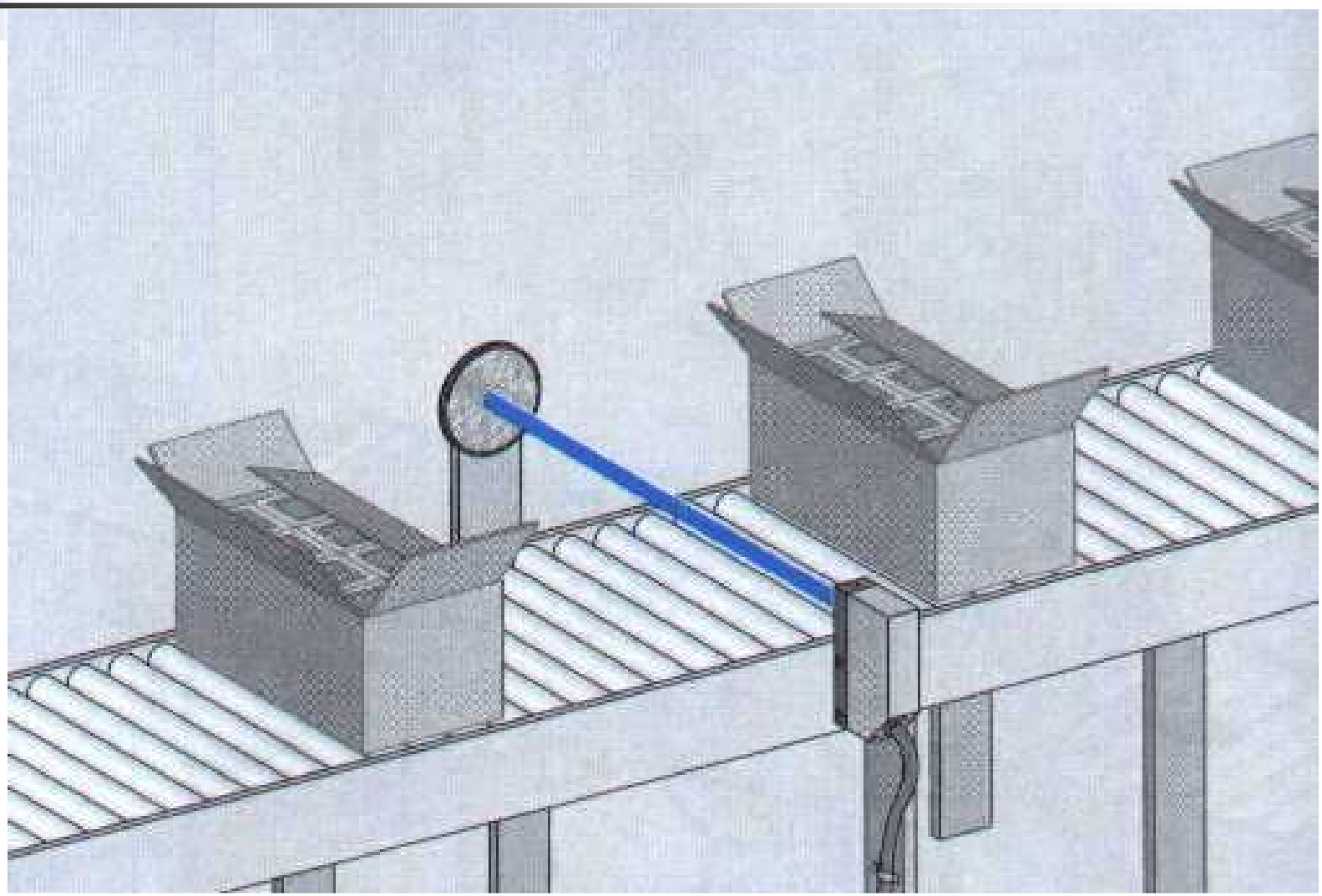
Kontrola: “Ima li ljepila?”



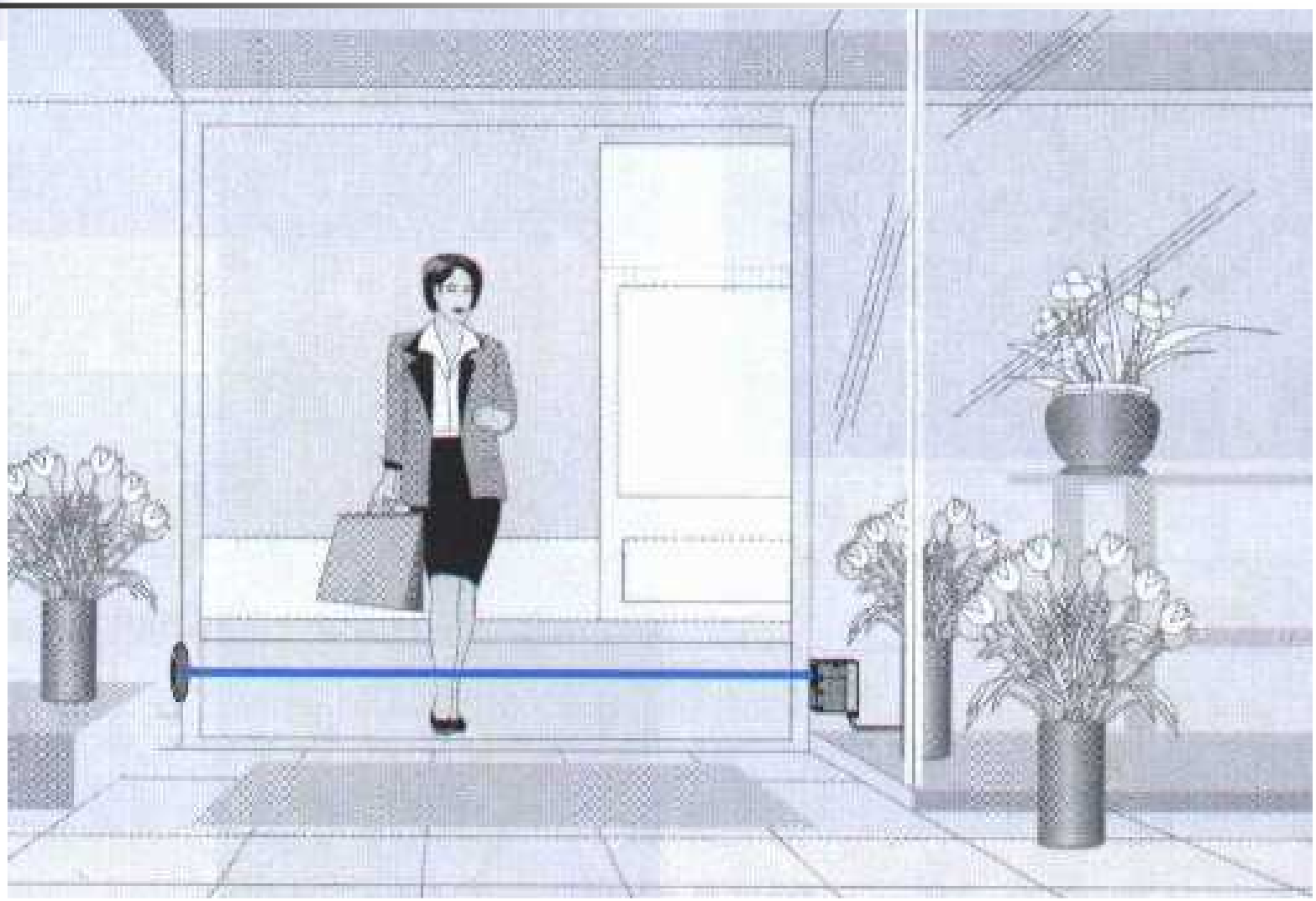
Detekcija petlje (rezerve materijala)



Kontrola prolaska i brojanje kutija

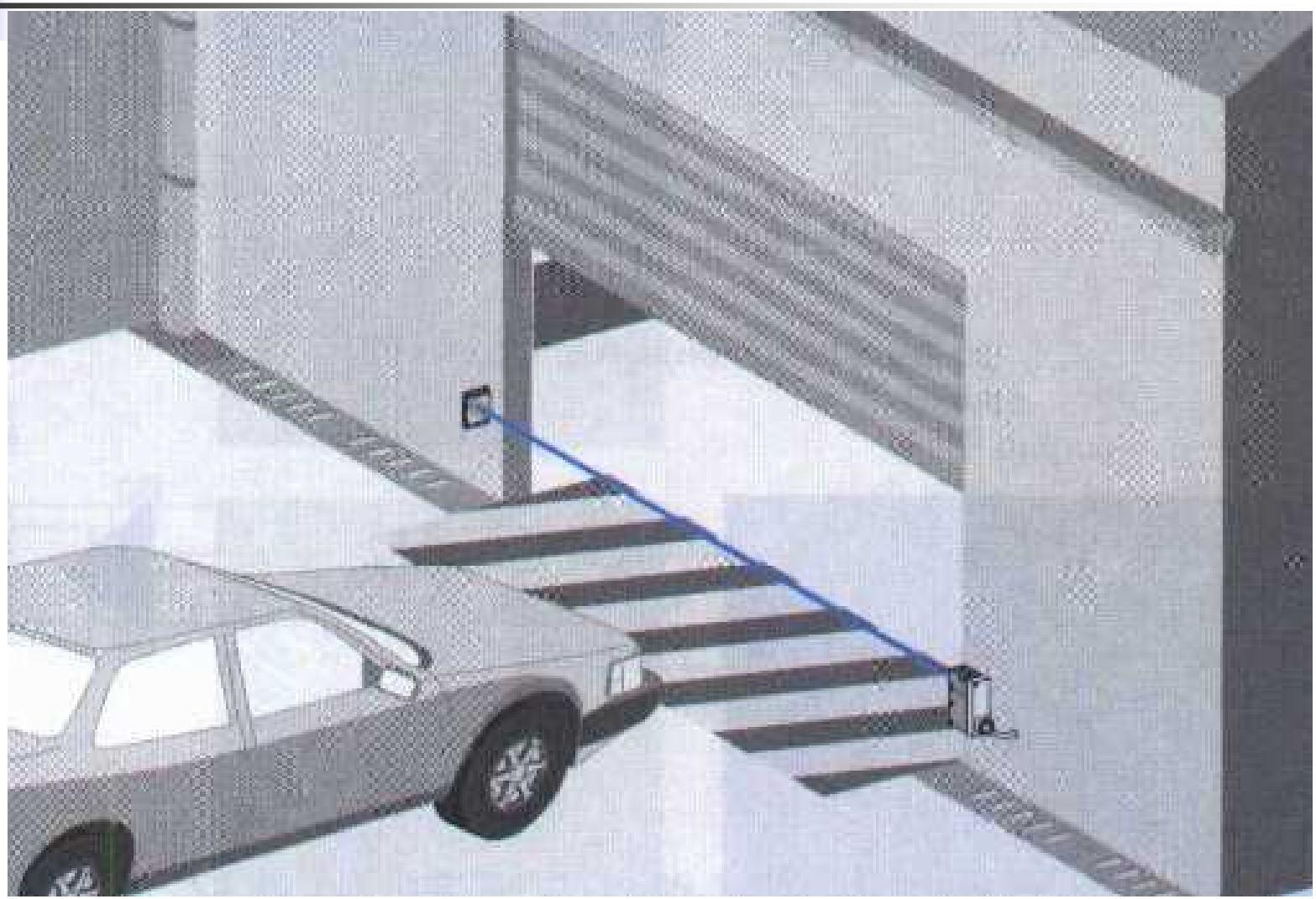


Detekcija nailaska osobe

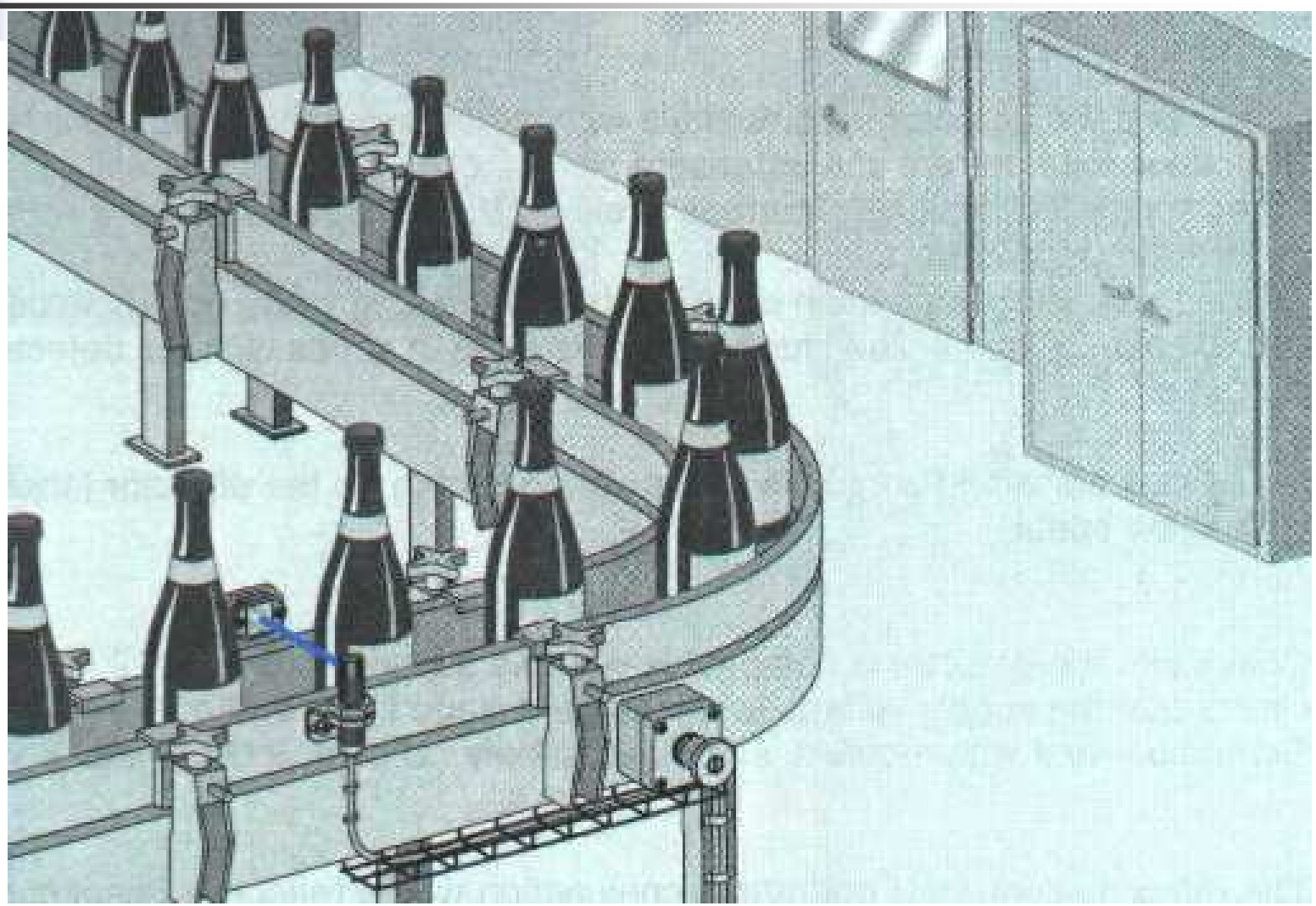


Zona nadzora (kontrole)

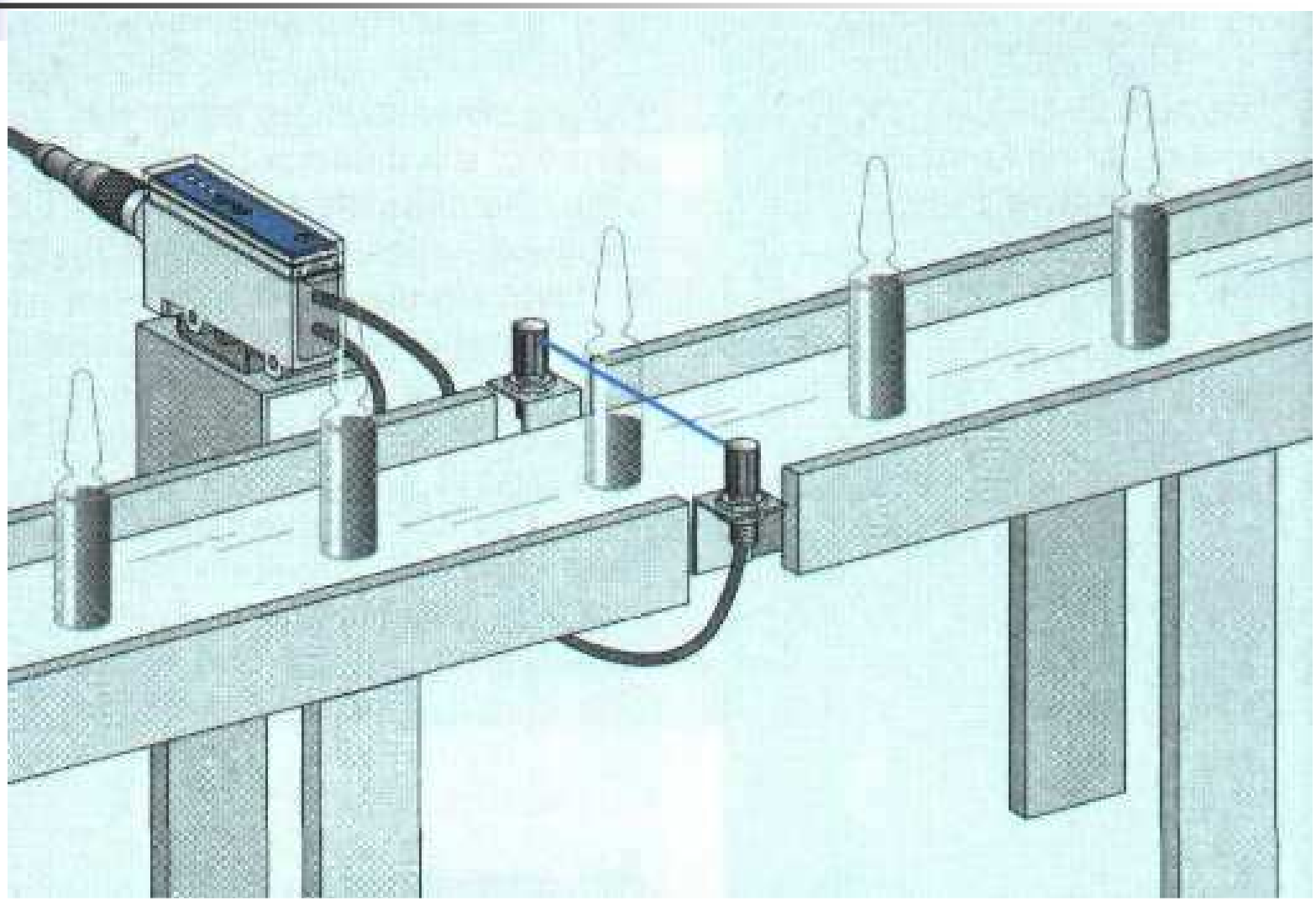
Upravljanje garažnim vratima



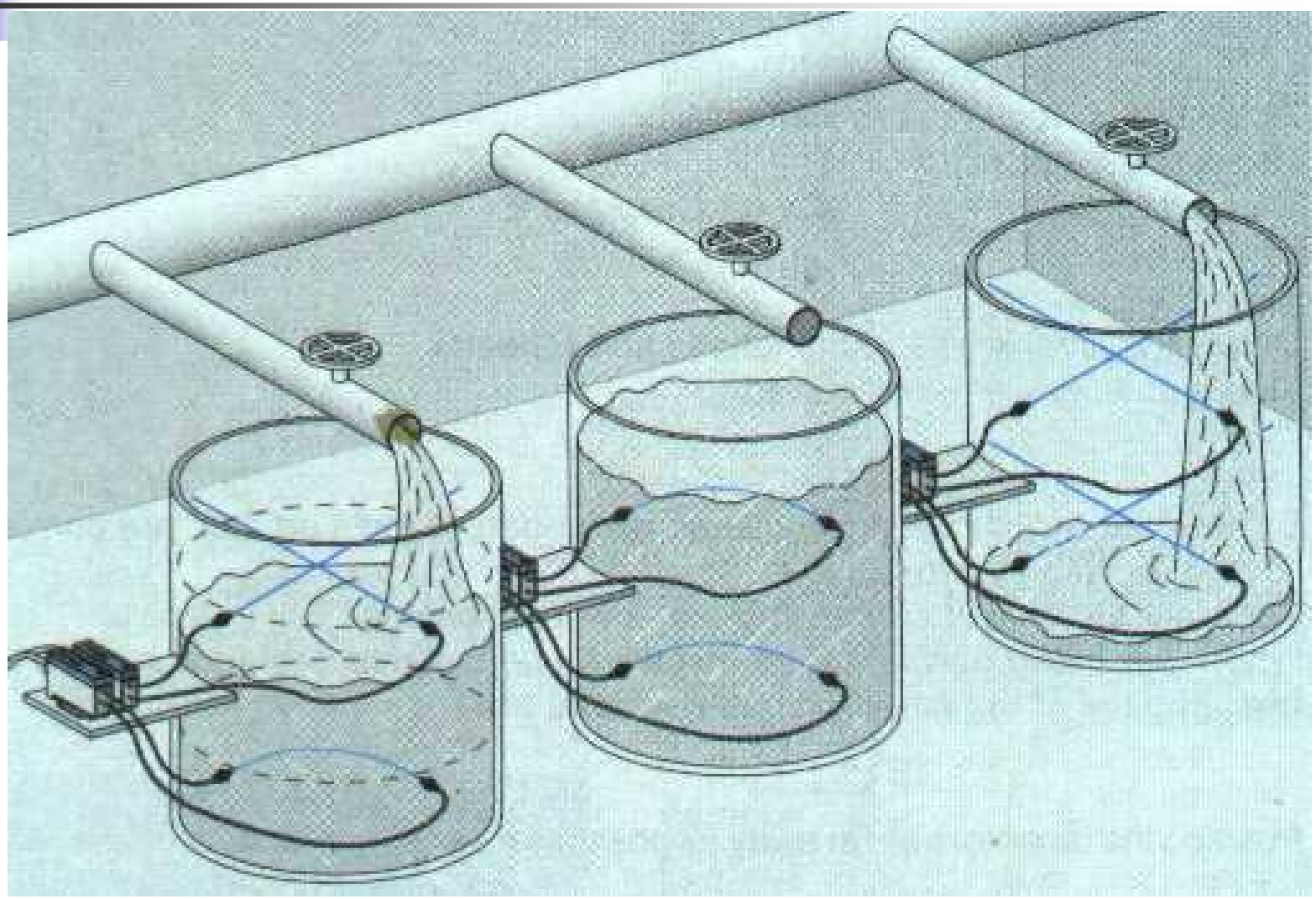
Kontrola prolaska i brojanje flaša



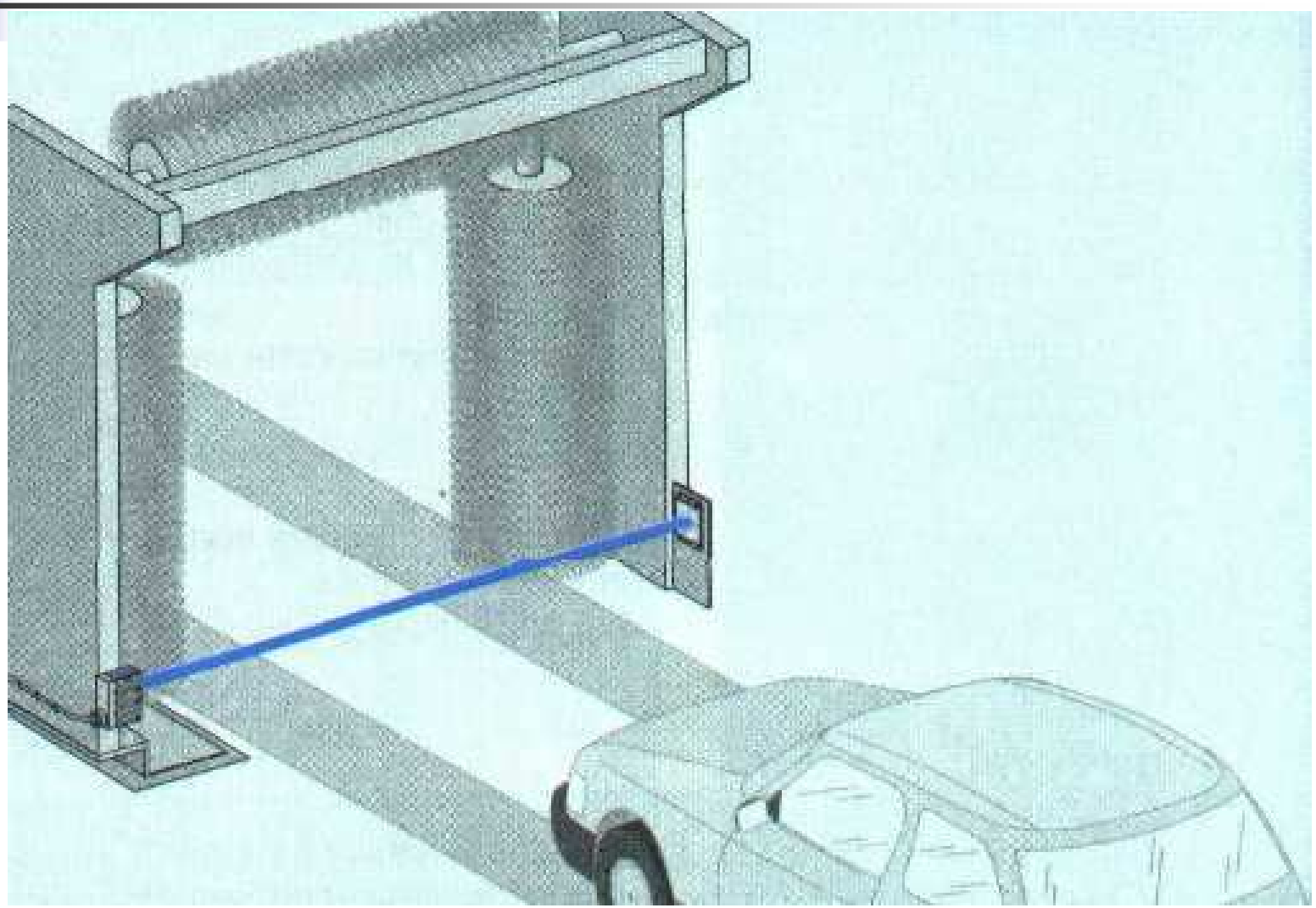
Provjera napunjenosti ampula

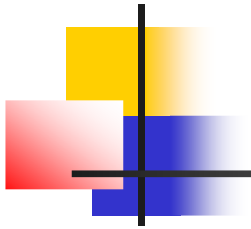


Nadgledanje nivoa vode u posudama



Upravljanje pogonima u automatskoj auto-perionici





Digitalni koderi i davači položaja

Digitalni koderi i davači položaja

Oblast u kojoj su optički senzori dominantni.

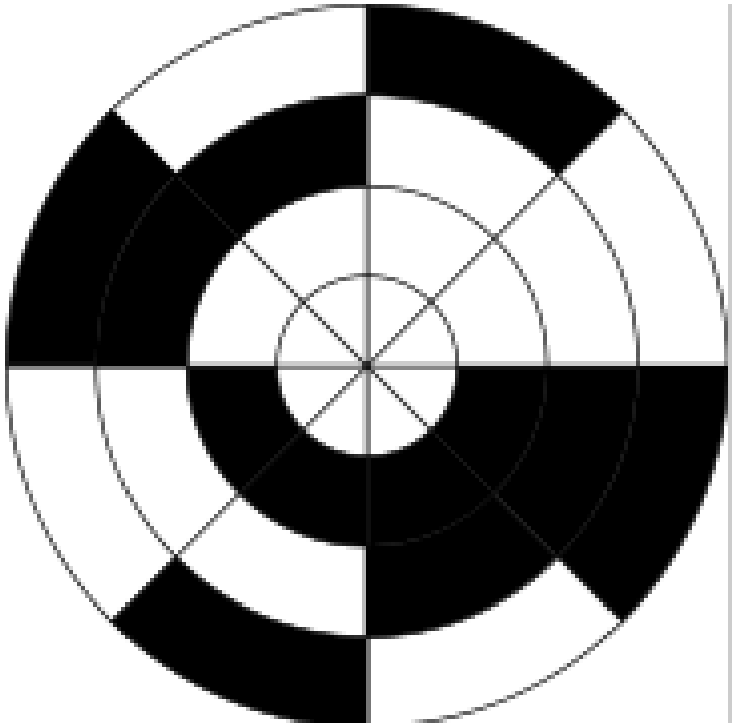
Dva osnovna tipa digitalnih kodera su: **apsolutni** i **inkrementalni**.

Podjela koja se pravi prema vrsti pomaka: **linijski** i **ugaoni**.

Podela prema smeru kretanja:
Jednokanalni (ne prati smer kretanja);
Dvokanalni (daje informaciju o smeru kretanja).

Apsolutni koderi

Apsolutni dekoderi daju jedinstven digitalni kod za svaku različitu poziciju objekta (osovine, vratila).



Sector	Contact 1	Contact 2	Contact 3	Angle
1	off	off	off	0° to 45°
2	off	off	on	45° to 90°
3	off	on	off	90° to 135°
4	off	on	on	135° to 180°
5	on	off	off	180° to 225°
6	on	off	on	225° to 270°
7	on	on	off	270° to 315°
8	on	on	on	315° to 360°

Grey-ov kod (apsolutni koderi)

Dva susjedna stanja razlikuju se za po jedan bit.

a)

B_2	B_1	B_0
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1

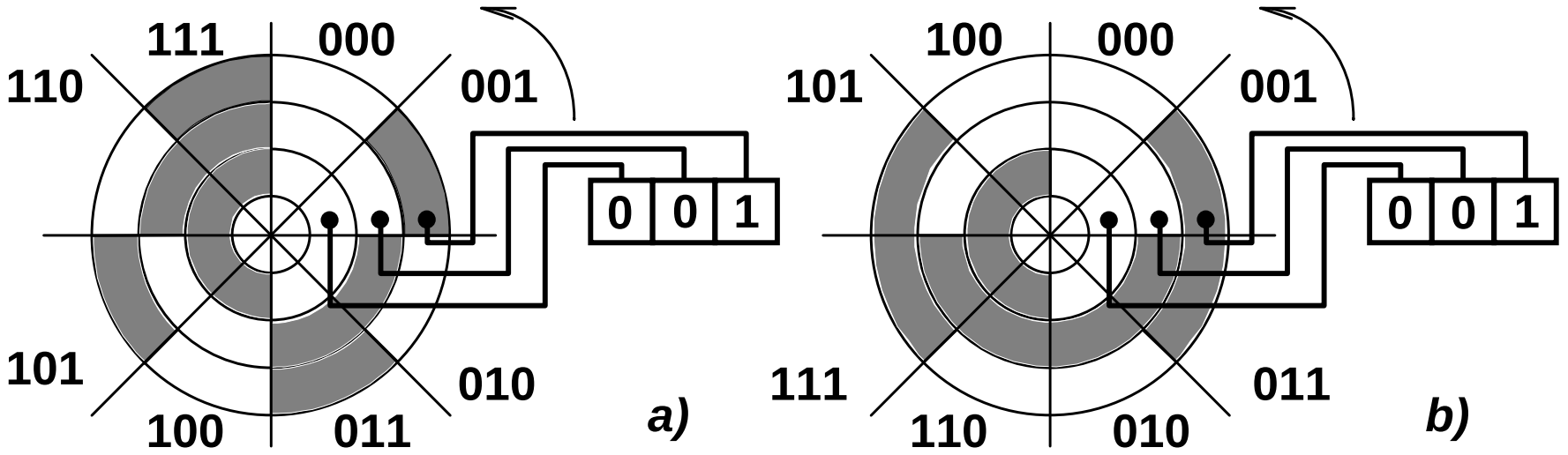
b)

G_2	G_1	G_0
0	0	0
0	0	1
0	1	1
0	1	0
1	1	0
1	1	1
1	0	1
1	0	0

Kombinacije tri bita: a) binarnom kodu i b) u Greyovom kodu.

G2=B2, G1=B2+B1, G0=B1+B0 (bez prenosa),

Grey-ov kod



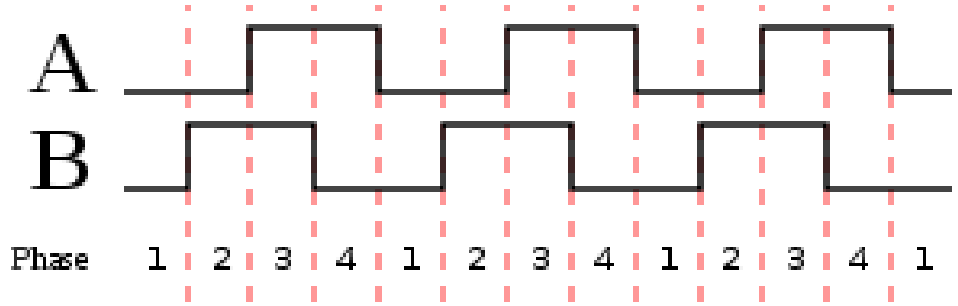
Dvije varijante diska za korišćenje 3-bitnog koda:

a) Prirodni kod; b) Greyov kod

http://en.wikipedia.org/wiki/Grey_codes

Inkrementalni koderi

Inkrementalni enkoderi imaju dva izlaza.



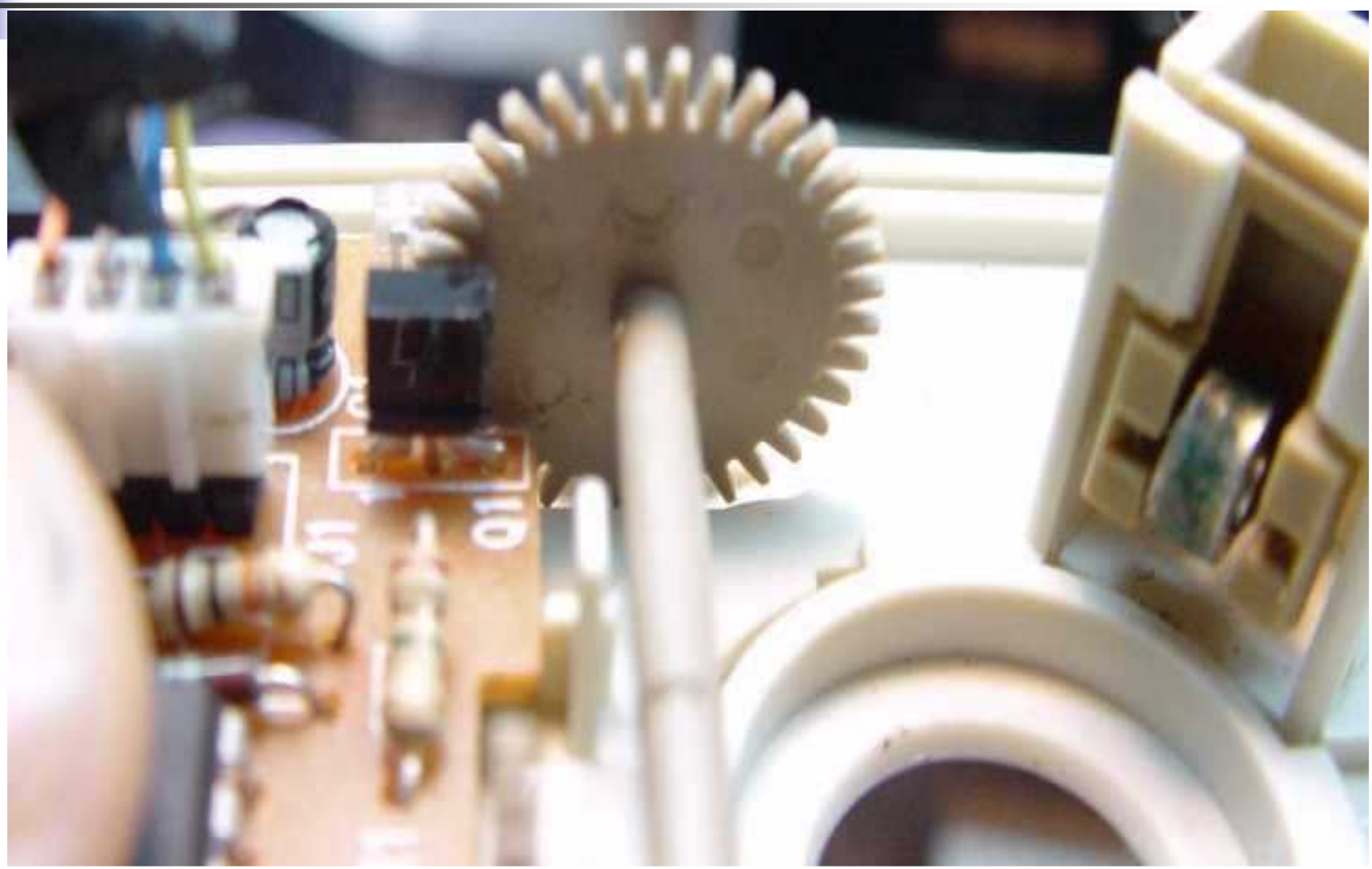
Gray coding for clockwise rotation

Phase	A	B
1	0	0
2	0	1
3	1	1
4	1	0

Gray coding for counter-clockwise rotation

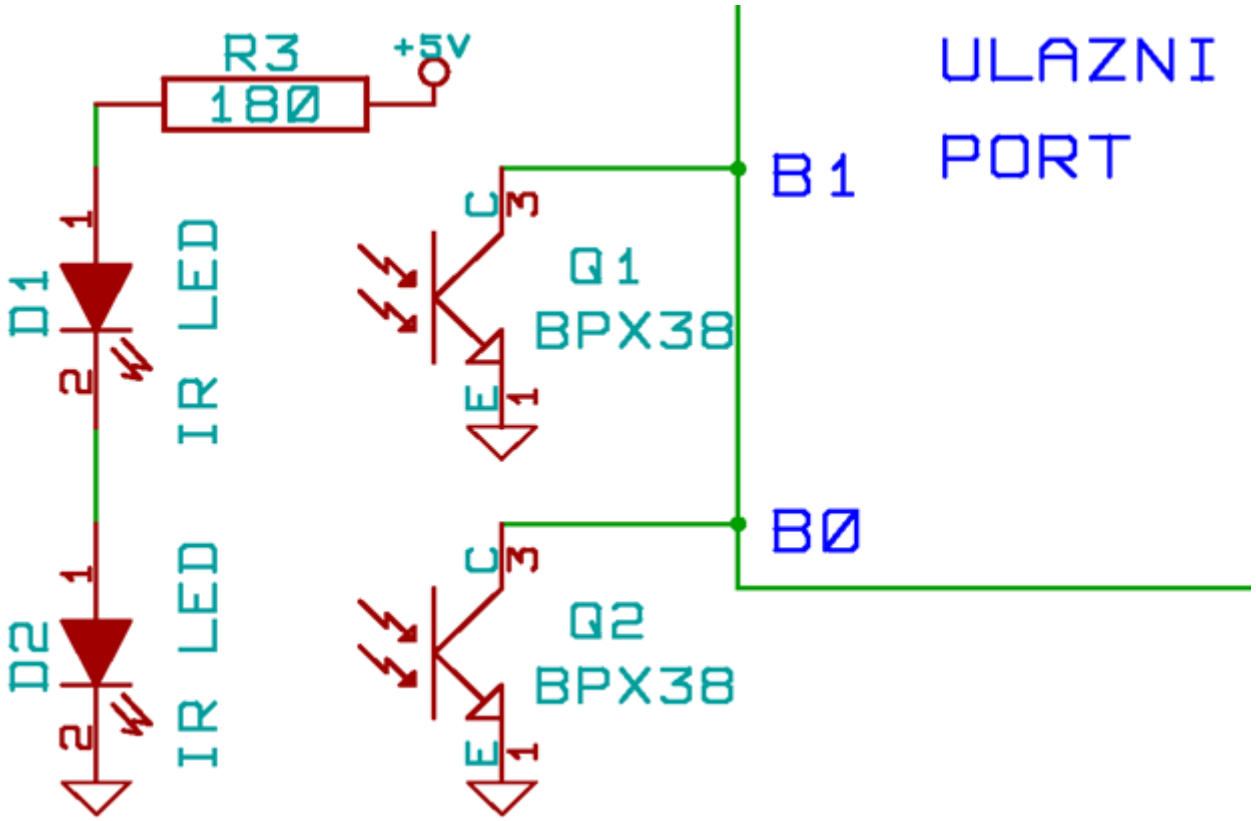
Phase	A	B
1	1	0
2	1	1
3	0	1
4	0	0

Inkrementalni davač sa zupčastim diskom



Optički interfejs (inkrementalni davač)

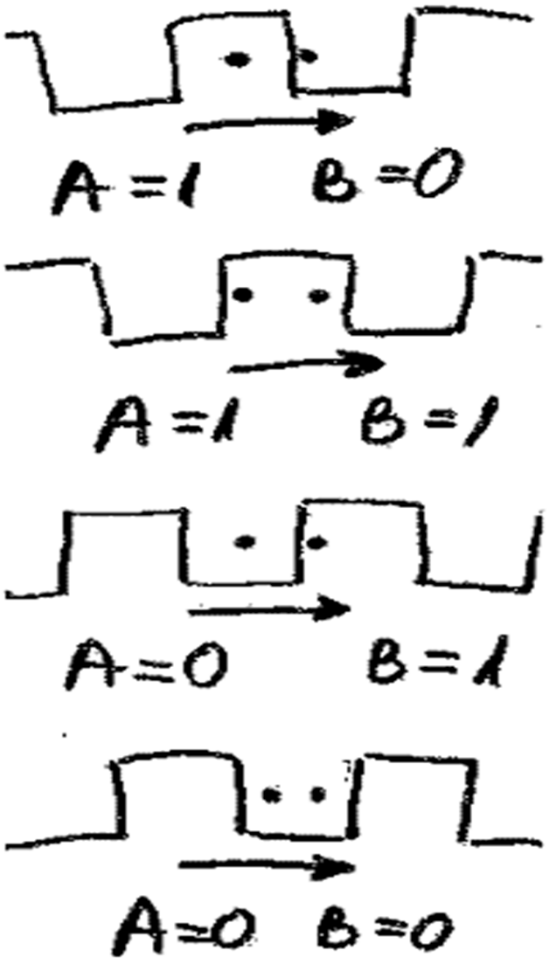
```
x=PINB & 3; // čitamo stanje fototranzistora
```

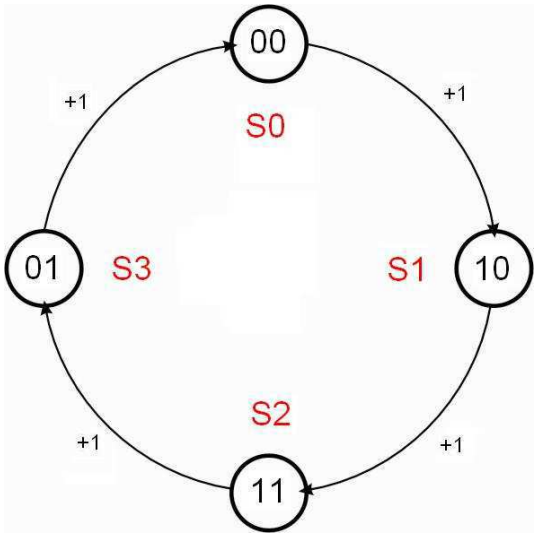


Program za jednokanalni inkrementalni davač položaja

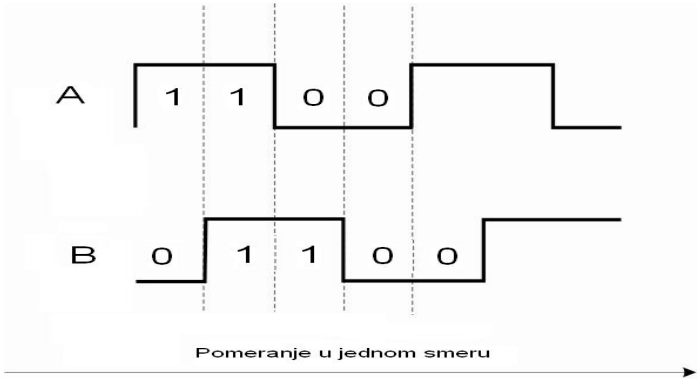
```
void loop()
{
    int y,staro;
    static int novo=0,p=0;

    y = PINB;
    Serial.println(y);

    staro=novo;
    novo=y & 1;
    if (novo==staro) return;
    p++;
    Serial.println(p);
}
```

Dijagram stanja – jedan smjer okretanja

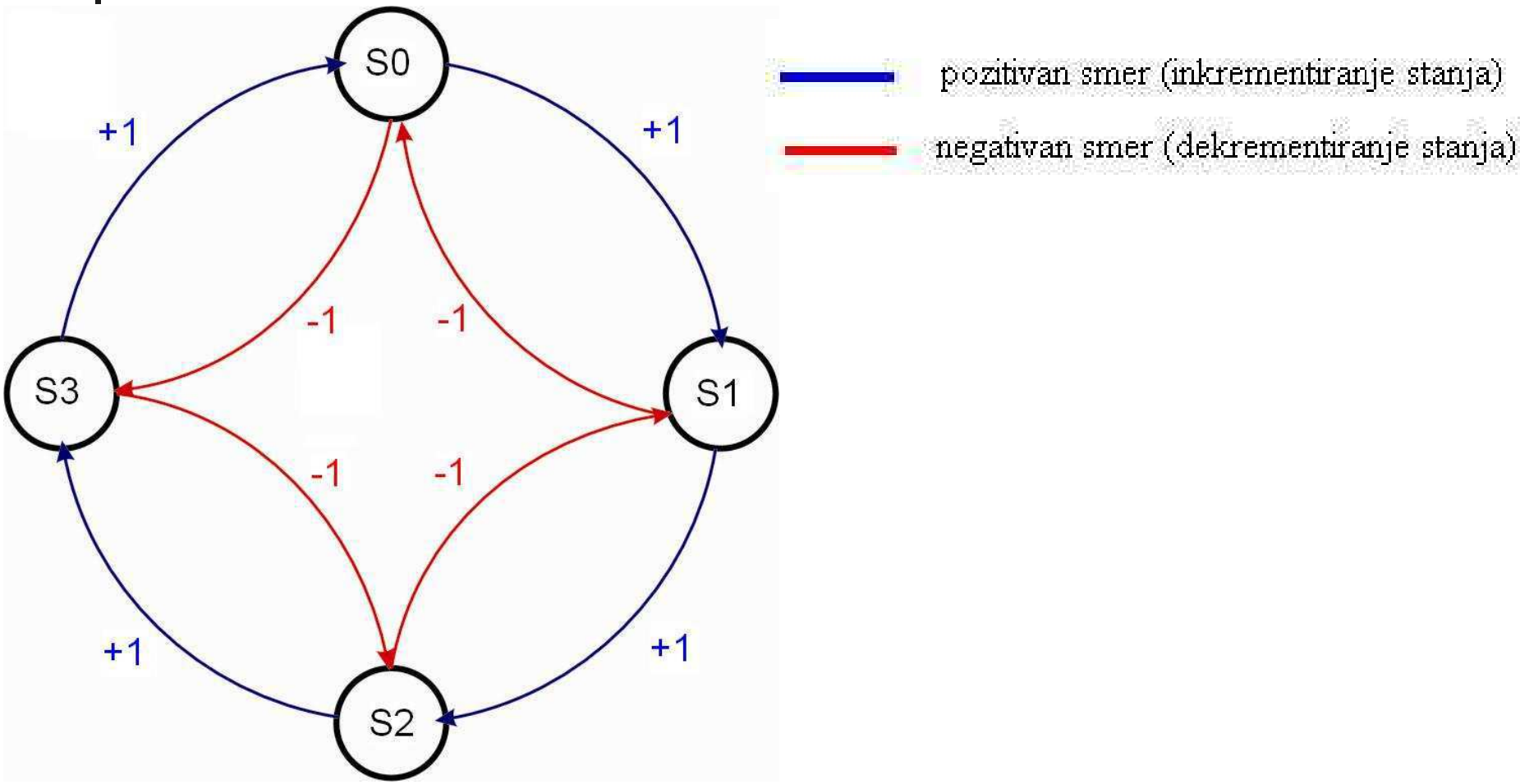




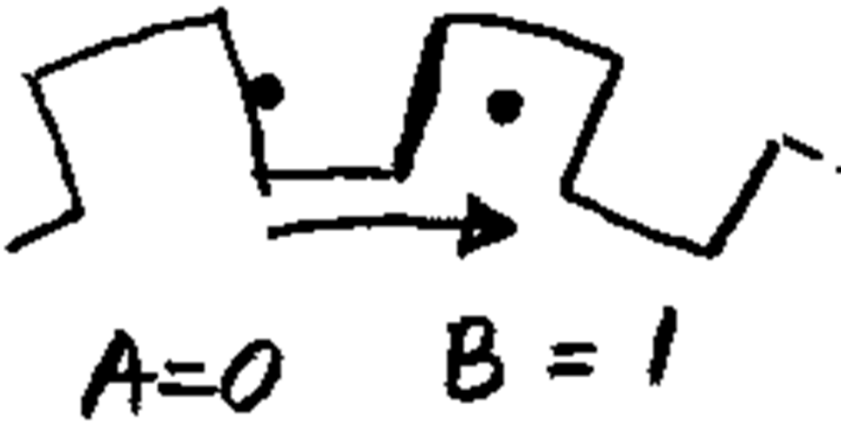
Pomeranje u pozitivnom smeru



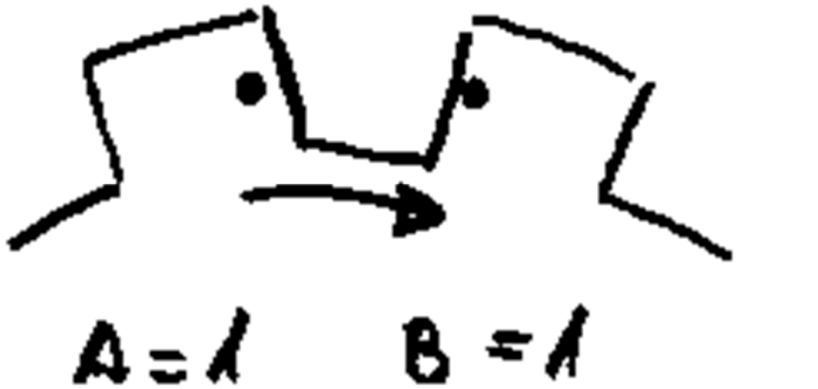
Redoslijed stanja za „+“ i „-“ smjer okretanja



Razmak između optičkih kanala



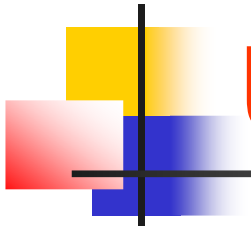
Razmak između optičkih kanala ne mora biti tačno 1/4 periode zubaca. Jednako su dobri razmaci 3/4, 5/4, 7/4,...



Program za dvokanalni inkrementalni davač položaja

```
void loop()
{ #define S0   0  /*A=0 B=0*/
   #define S1   2  /*A=1 B=0*/
   #define S2   3  /*A=1 B=1*/
   #define S3   1  /*A=0 B=1*/

    int  staro;
    static int novo=0, p=0;

    staro=novo;
    novo=PINB & 3;
    if (novo==staro) return;
```

```
    switch(staro){
      case S0: if(novo==S1) p++;
               if(novo==S3) p--; break;
      case S1: if(novo==S2) p++;
               if(novo==S0) p--; break;
      case S2: if(novo==S3) p++;
               if(novo==S1) p--; break;
      case S3: if(novo==S0) p++;
               if(novo==S2) p--; break;
    } /* kraj switch petlje */
    Serial.println(p);

} /* Kraj programa*/
```

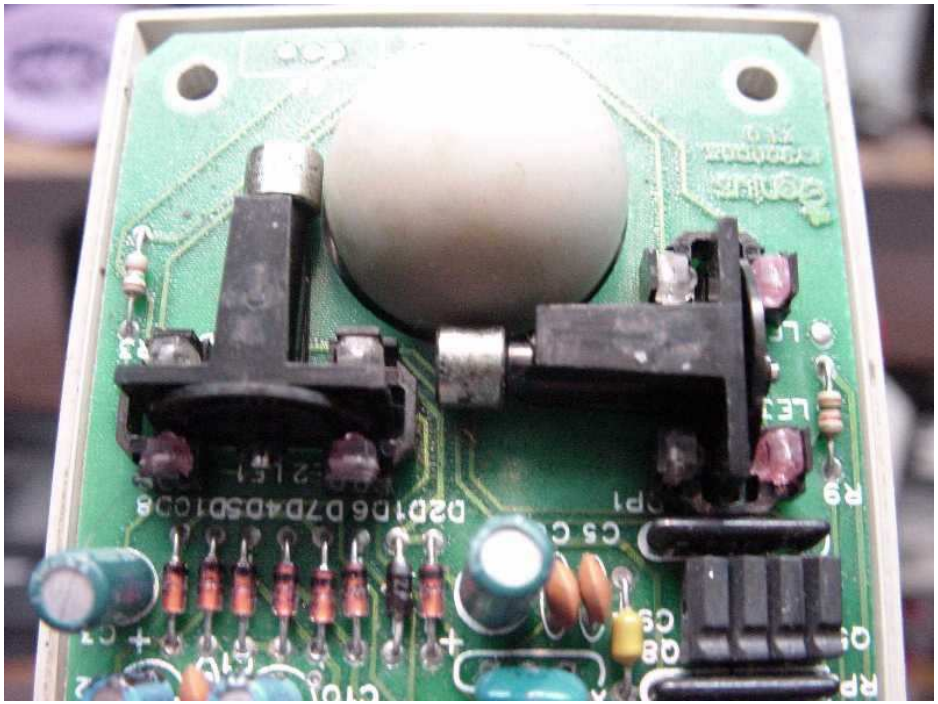


Učestanost čitanja porta

Učestanost čitanja porta mora biti podešena tako da se svaka promjena stanja na portu registruje.

Ako je učestanost čitanja porta u odnosu na brzinu promjene stanja na ulazu u port preniska, svaka promjena neće biti registrovana. Tada ćemo imati preskoke stanja i dobićemo pogrešnu poziciju.

X i Y inkrementalni davači (dva dvokanalna inkr. davača)



Iako se inkrementalni davači više ne koriste u miševima, u ostalim oblastima su nezamjenljivi. Korsite se za mjerenje položaja, linearne brzine, ugla, brzine obrtanja, i mjerenje svih veličina koje se mogu pretvoriti u pomjeraj kao što su težina, sila, pritisak, nivo, itd.

Laserska mjerila sa inkrementalnim enkoderom

kljunasto mjerilo

mikrometar

tahometar

Laserski izvor svijetla omogućava inkrementalnom enkoderu više impulsa po jedinici dužine i preciznije mjerenje.

Za vježbu

1. Prekidač otvoren – jednokanalni inkrementalni davač. Prekidač zatvoren – dvokanalni inkrementalni davač. (2 boda)
2. Ako je prekidač zatvoren promjena smjera kratanja letve mijenja smjer okretanja koračnog motora. Ako je prekidač otvoren, promjena smjera kretanja letve nema uticaja. (3 boda)
3. Pokretanje letve pokreće koračni motor. Promjena smjera kratanja letve mijenja smjer okretanja koračnog motora. Ako se letvom napravi 5 ili više koraka u jednom smjeru zaustavlja se koračni motor. Pravljenje koraka u suprotnom smjeru pokreće koračni motor. **(4 boda)**