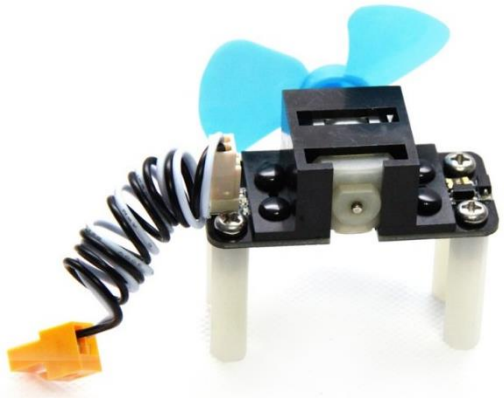
Human Inputting Devices for DC Motor Control

Class 3: Photoelectrics and Light based Applications



July 26, 2017

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Presented by:

DesignNews CEC CONTINUING EDUCATION CENTER

Digi-Key ELECTRONICS ROHDE&SCHWARZ

Photoelectrics and Light based Applications

Agenda

- Photoelectric Devices
- Photoelectric Sensors
- Exploring the Me Light Sensor
- Hands-On Project: Safety Controls

Photoelectric Devices

- Often contain solid state switches.
- Solid state switches has
  - a) no moving parts (contacts)
  - b) a SCR (Silicon Controlled Rectifier)
  - c) NPN (current sink) transistor
  - d) PNP (current source) transistor
- Triacs (A solid state AC Switch) is used for switching AC loads

Source:

Electrical Motor Controls for Integrated Systems, 5th ed, G.J. Rockis, G.A. Mazur

Photoelectric Devices…

- The SCR output is used for switching high power DC loads.
- The current sink and current source transistor outputs are used for switching low power DC loads.

Source:

Electrical Motor Controls for Integrated Systems, 5th ed, G.J. Rockis, G.A. Mazur

Question 1

What bipolar transistor is used to source a small electrical or electronics load?

a) NPN

b) PNP

c) Darlington

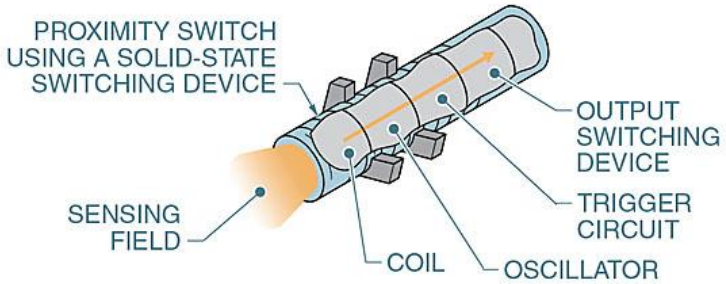
d) None of the above

Photoelectric Devices…

Output Switching devices Summary:

OUTPUT SWITCHING DEVICES

Device	Use
TRIAC	Switch AC loads
SCR	Switch high-power DC loads
NPN TRANSISTOR, PNP TRANSISTOR	Switch low-power DC loads



SOLID-STATE SWITCHES

Source:

Electrical Motor Controls for Integrated Systems, 5th ed, G.J. Rockis, G.A. Mazur

Photoelectric Devices…

Examples:

Semiconductor based Photoelectric Devices

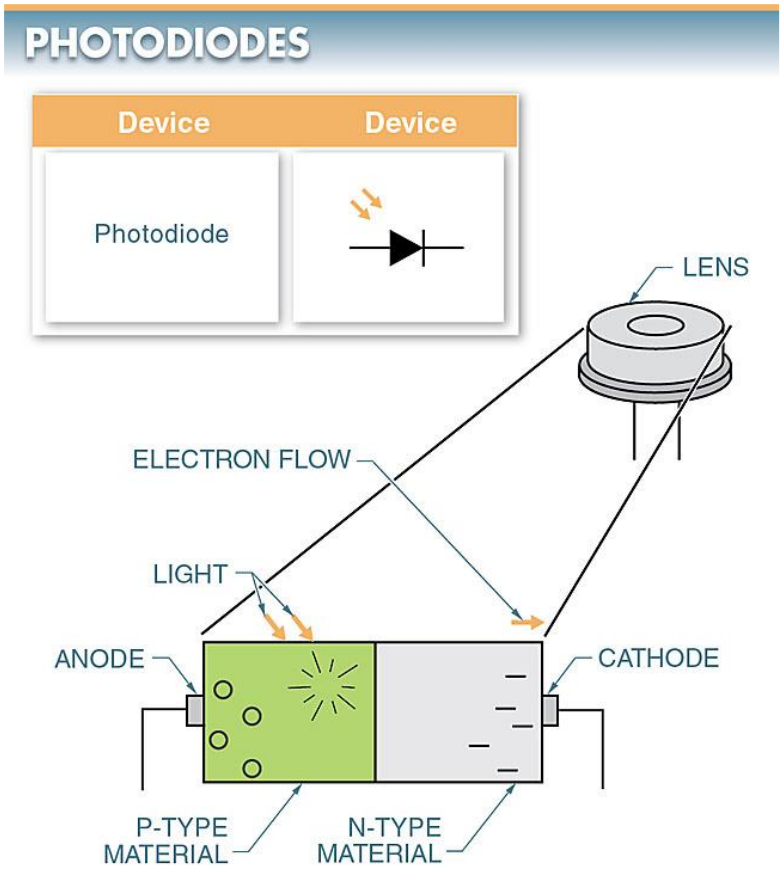
Photo-diode

Opto coupler: photo-triac based

Photo-transistor

Photoelectric Devices…

Photodiode symbol and semiconductor structure



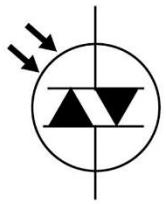
Source:

Electrical Motor Controls for Integrated Systems, 5th ed, G.J. Rockis, G.A. Mazur

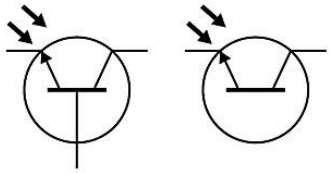
Photoelectric Devices…

Electronic symbols

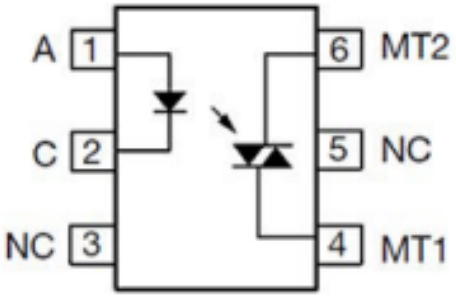
PHOTOTRIACS

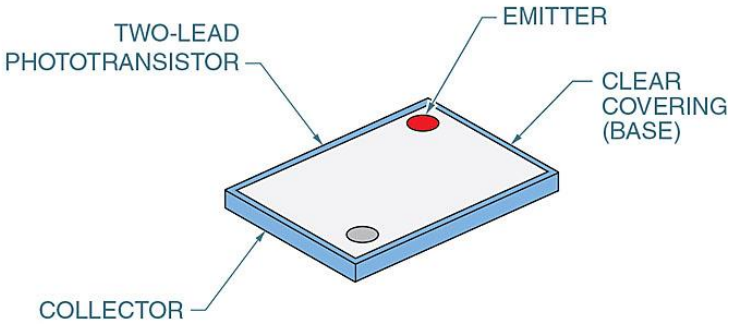
Device	Symbol
PHOTOTRIAC	

PHOTOTRANSISTORS

Device	Symbol
PHOTOTRANSISTOR	

6 pin DIP or SMD IC package





Sources:

Electrical Motor Controls for Integrated Systems, 5th ed, G.J. Rockis, G.A. Mazur

http://www.vishay.com/docs/84780/appnote34.pdf

Question 2

Double arrows pointing towards the electronic symbol ties in with what photoelectric operation.

a) detector

b) emitter

c) transceiver

d) None of the above

Photoelectric Sensor…

- Solid state sensor that can detect the presence of an object without touching the object.
- Object detection done with a beam of light.
- Solid state outputs are use to control the flow of electric current.

Photoelectric Sensor…

- Solid state outputs may be:

  a) Thyristor (used for switching AC circuits).

  b) NPN or PNP transistor (used for switching DC circuits).

- Output selected depends on specific application needs detection done with a beam of light.
- Solid state outputs are use to control the flow of electric current.

Photoelectric Sensors…

- Solid state outputs may be:

  a) Thyristor (used for switching AC circuits).

  b) NPN or PNP transistor (used for switching DC circuits).

- Output selected depends on specific application needs.

Photoelectric Sensors…

- Considerations that affect the solid-state output include the following:

  a) Voltage type to be switched – AC or DC.

  b) Amount of current to be switched (few amperes, milliamperes or microamperes)

  i. If current is within a few amperes and electrical interface is needed.

  ii. An electromechanical or solid state relay is the most common interface used with photoelectric devices.

Question 3

A solid state output may be____.

Photoelectric Sensors…

Examples:

Semiconductor Photoelectric Sensors

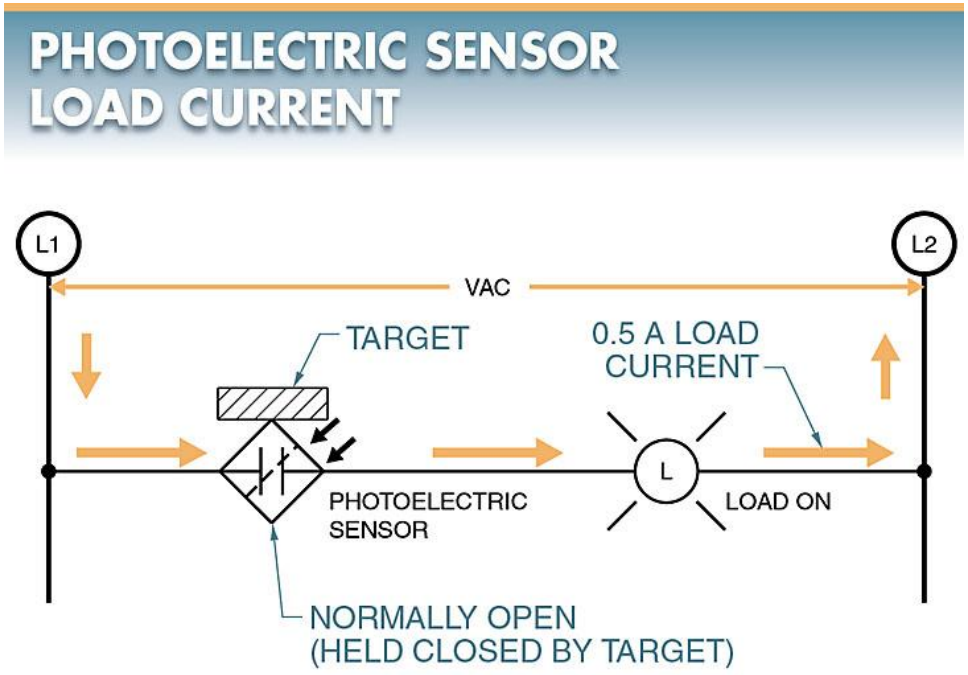
Proximity Sensor:
a) **AC or DC switching types**
b) **Object detection**

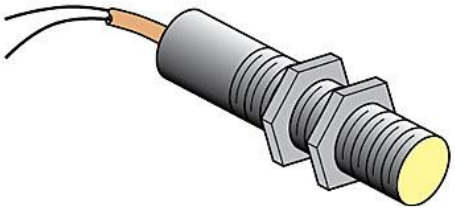
Photo-transistor:
a) **NPN or PNP switching types**
b) **Object detection**

Photoelectric Sensors…

Examples:

Proximity Sensor Object Detection Circuit





Exploring the Me Light Sensor

- Can detect ambient light intensity.
- An onboard phototransistor to detect ambient light intensity.
- Operates off of +5VDC.
- Provides an analog signal voltage range of 0 - 4.8VDC.
- Dimensions: 52x24x16mm (Length x Width x Height)

Exploring the Me Light Sensor…

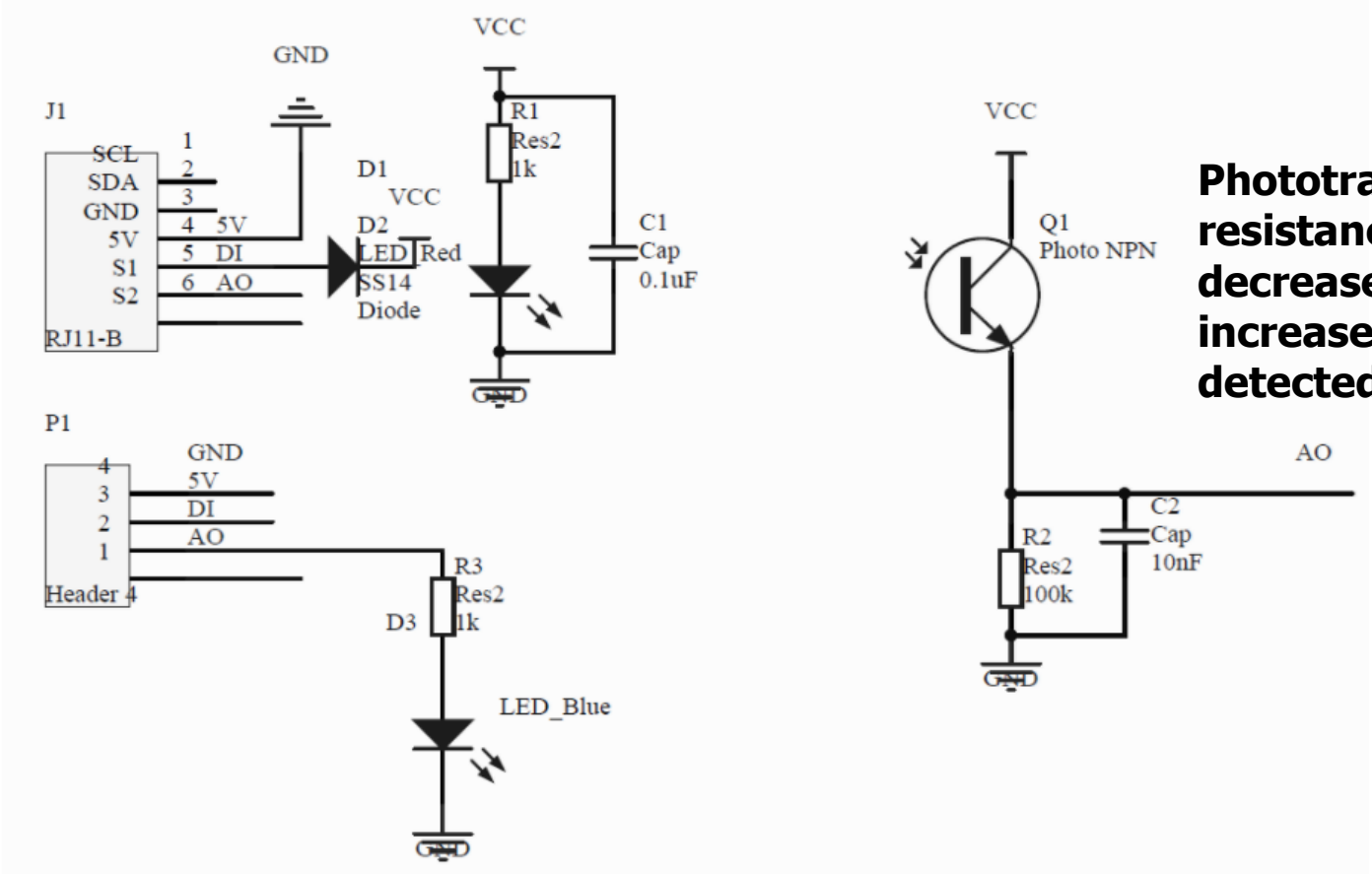
Data Values based on lighting conditions

Analog Values

daylight	night	indoor
>500	0-100	100-500

Exploring the Me Light Sensor…

Me Light Sensor Circuit Schematic Diagram



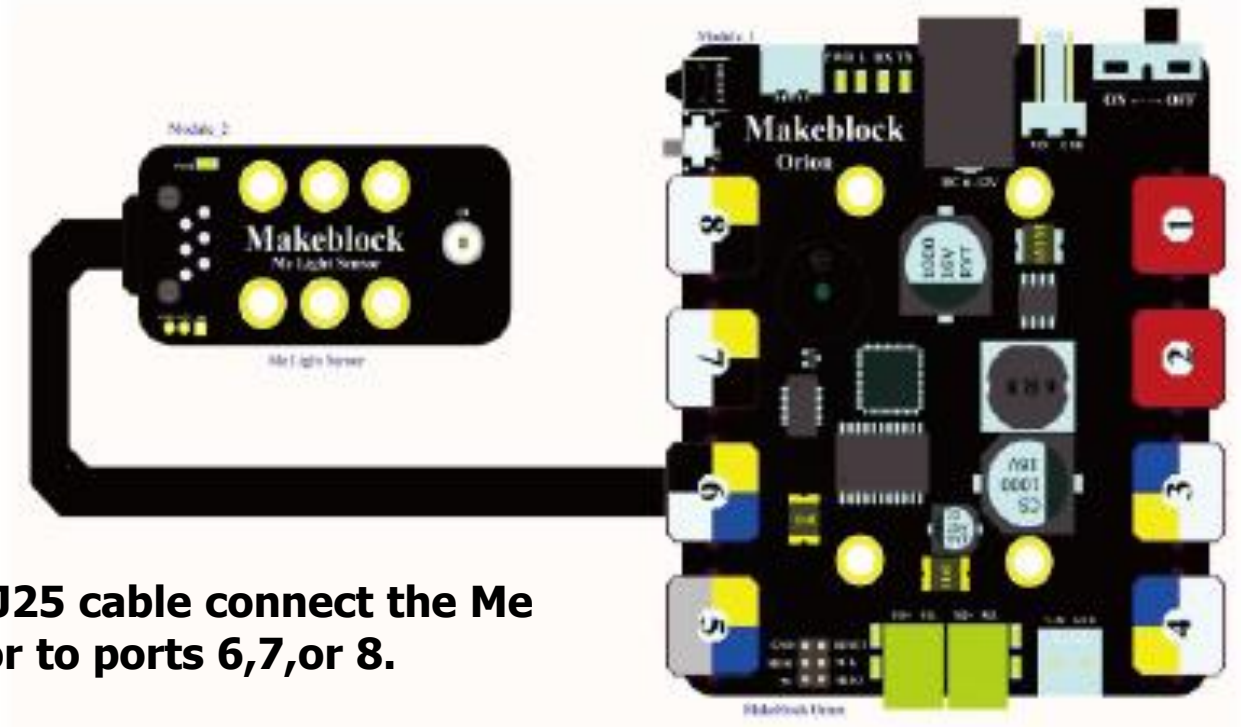
Phototransistor's resistance decrease with an increase in detected light.

Sources:

http://learn.makeblock.com/en/me-light-sensor/

Exploring the Me Light Sensor…

Attaching the Me Light Sensor to a Me-Orion Controller



Using an RJ25 cable connect the Me Light sensor to ports 6,7,or 8.

Sources:

http://learn.makeblock.com/en/me-light-sensor/

Exploring the Me Light Sensor…

Arduino Test Code for Me Light Sensor

```
#include "MeOrion.h"
#include <Wire.h>
#include <SoftwareSerial.h>

MeLightSensor lightSensor(PORT_6);

int value = 0;

void setup()
{
    Serial.begin(9600);
}

void loop()
{
      value=lightSensor.read();
      Serial.print("value = ");
      Serial.println(value);
      delay(100);
}
```

Exploring the Me Light Sensor…

Output Light Level readings from Me Light Sensor

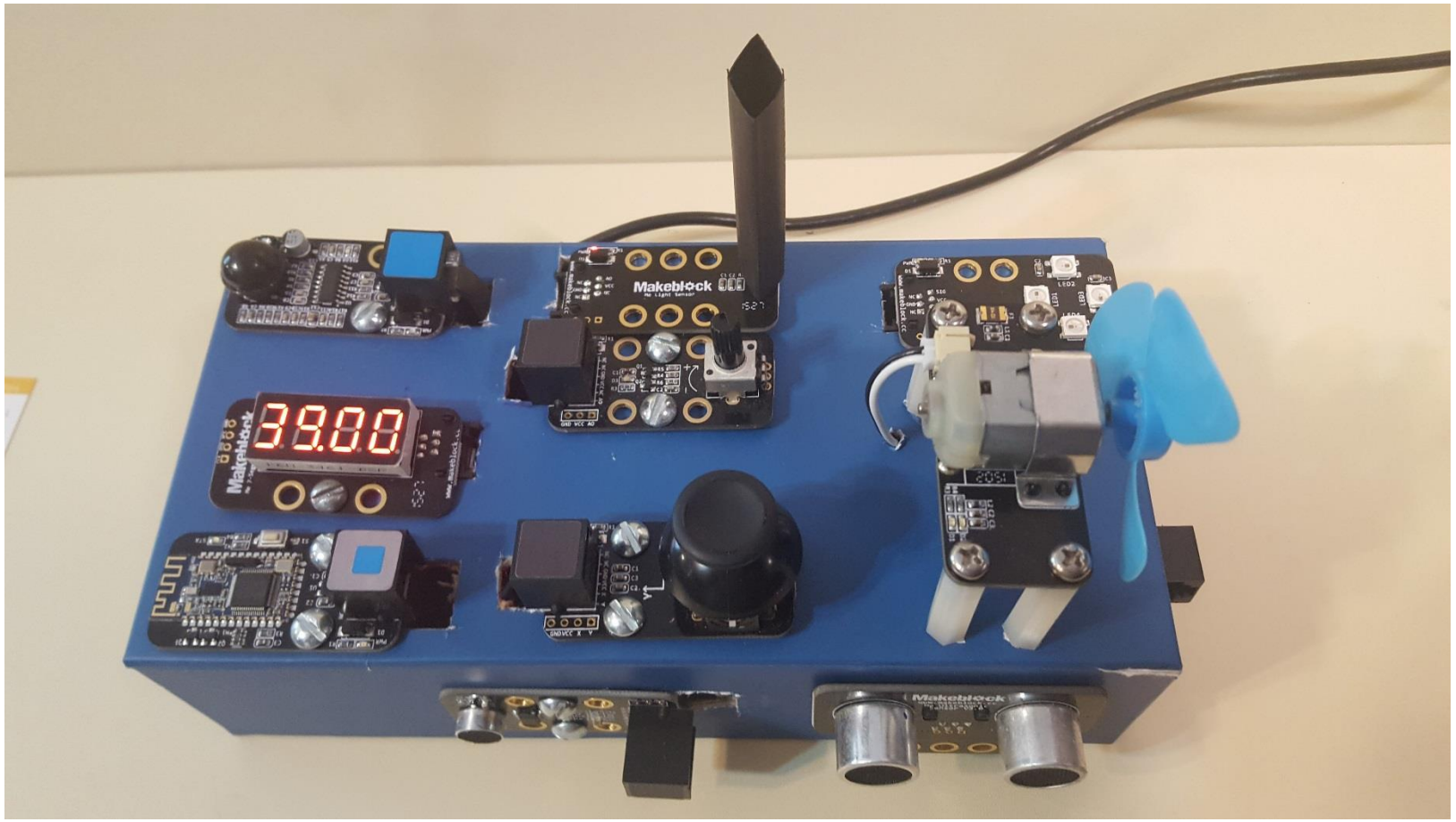
COM4

```
value = 971
value = 558
value = 376
value = 197
value = 151
value = 130
value = 119
value = 115
value = 109
value = 102
value = 94
value = 83
value = 78
value = 75
value = 71
value = 70
value = 69
value = 66
value = 66
value = 66
value = 65
value = 64
value = 63
```

Question 4

Write the line of code that initializes the “value” variable.

Hands-On Project: Safety Controls



Hands-On Project: Safety Controls…

Project Objectives:

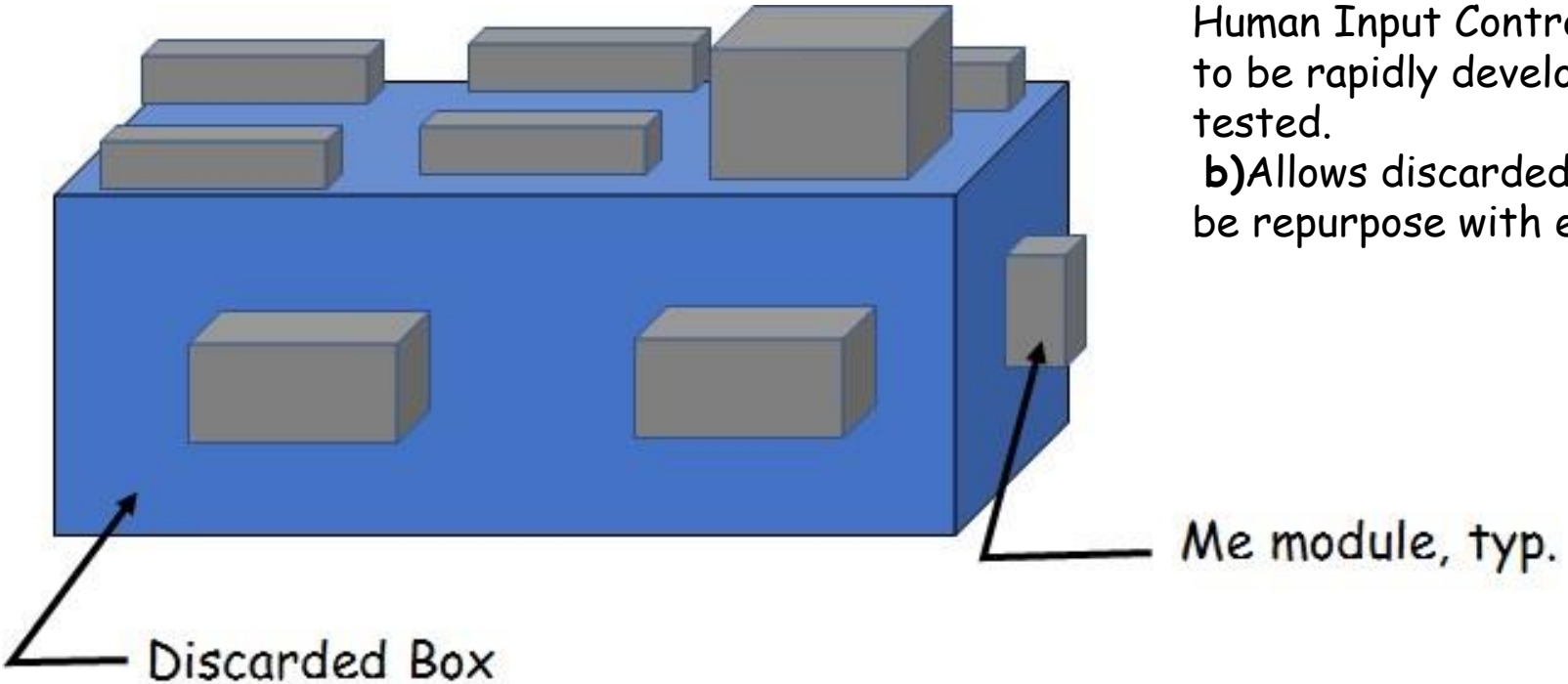
a) Build a prototyping technology trainer for testing Human Inputting Devices concepts.

b) Design a safety controls (light curtain) where placing your hand in front of a sensor will turn off a fan.

c) Prototype photoelectric sensor input controls that perform Design Feature b.

Hands-On Project: Safety Controls…

Human Inputting Device Technology Box: Concept Drawing



The BIG IDEAs:

a) Technology Box allows Human Input Control Designs to be rapidly developed and tested.

b) Allows discarded items to be repurpose with electronics.

Hands-On Project: Safety Controls…

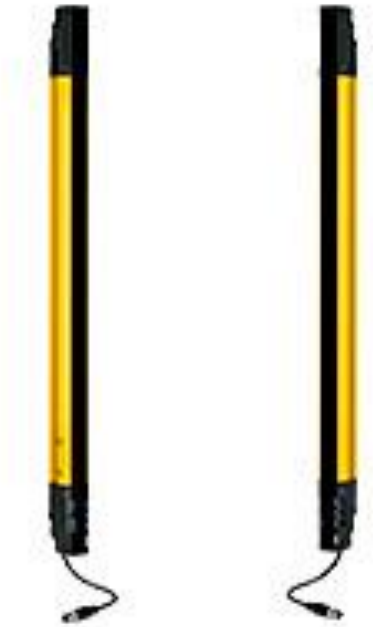
What is a Safety Light Curtain?

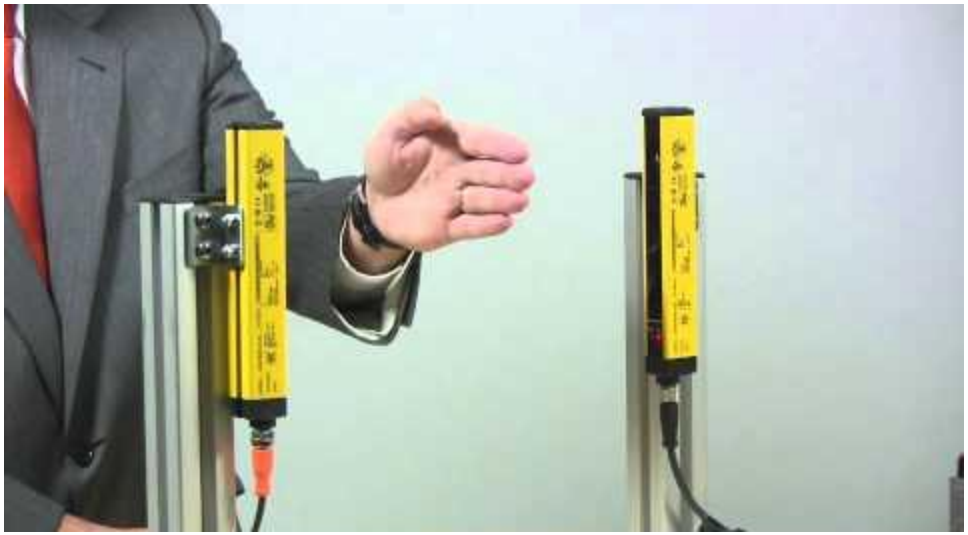
Safety **light curtains** are opto-electronic devices that are used to safeguard personnel in the vicinity of moving machinery with the potential to cause harm such as presses, conveyor systems, and palletizers.

Source:
https://en.wikipedia.org/wiki/Light_curtain

Hands-On Project: Safety Controls…

Examples: **Safety Light Curtains**

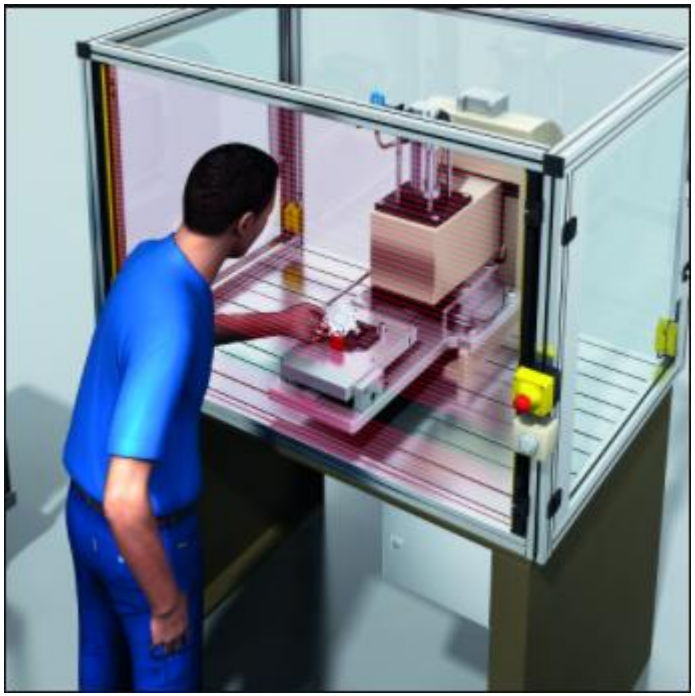




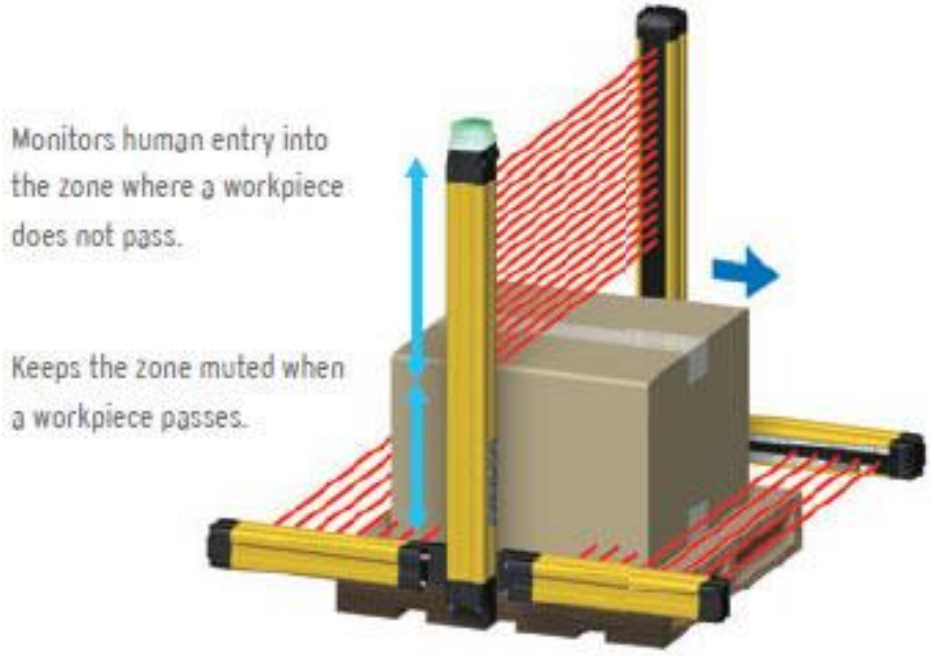
Hands-On Project: Safety Controls…

Example Applications:

Machine Controls



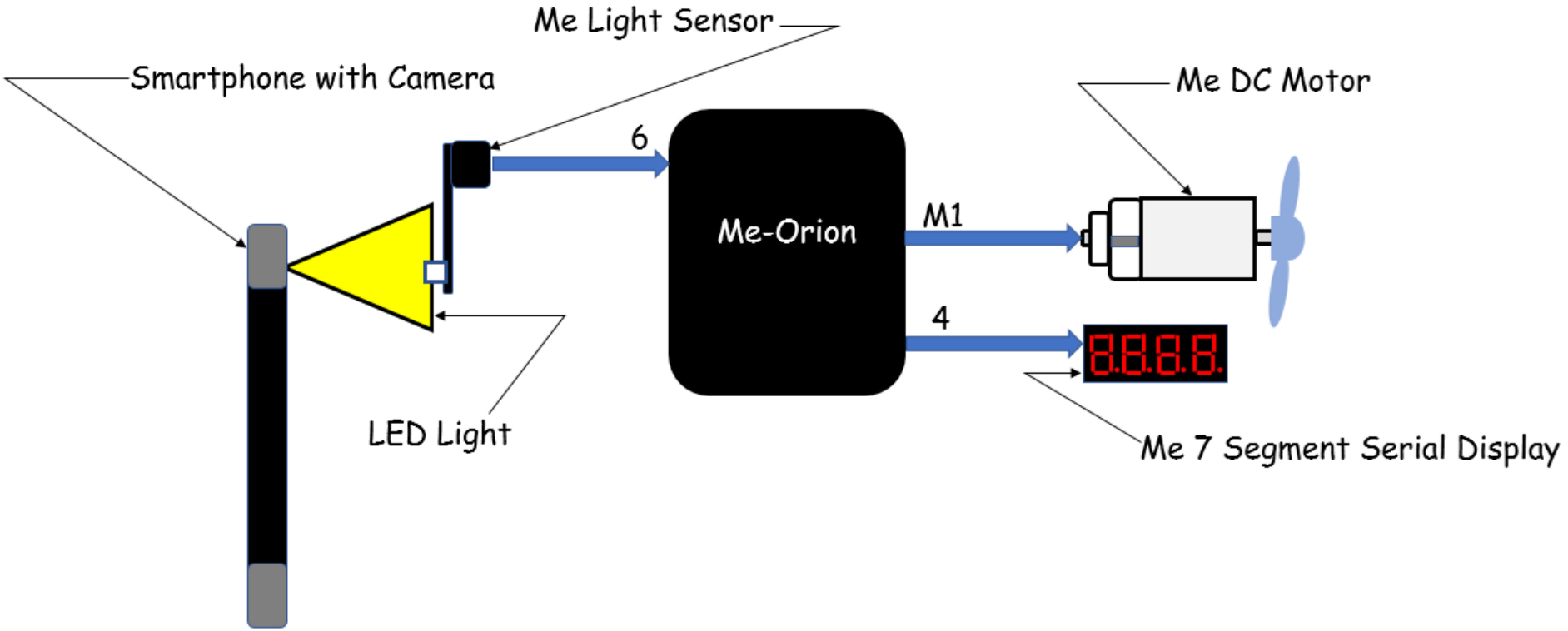
Palletizing



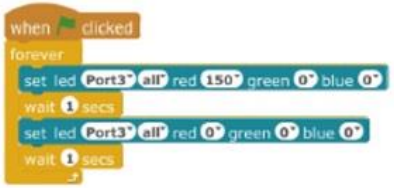
Source:
https://www.webproxp.com/safety-light-curtains/

Hands-On Project: Safety Controls…

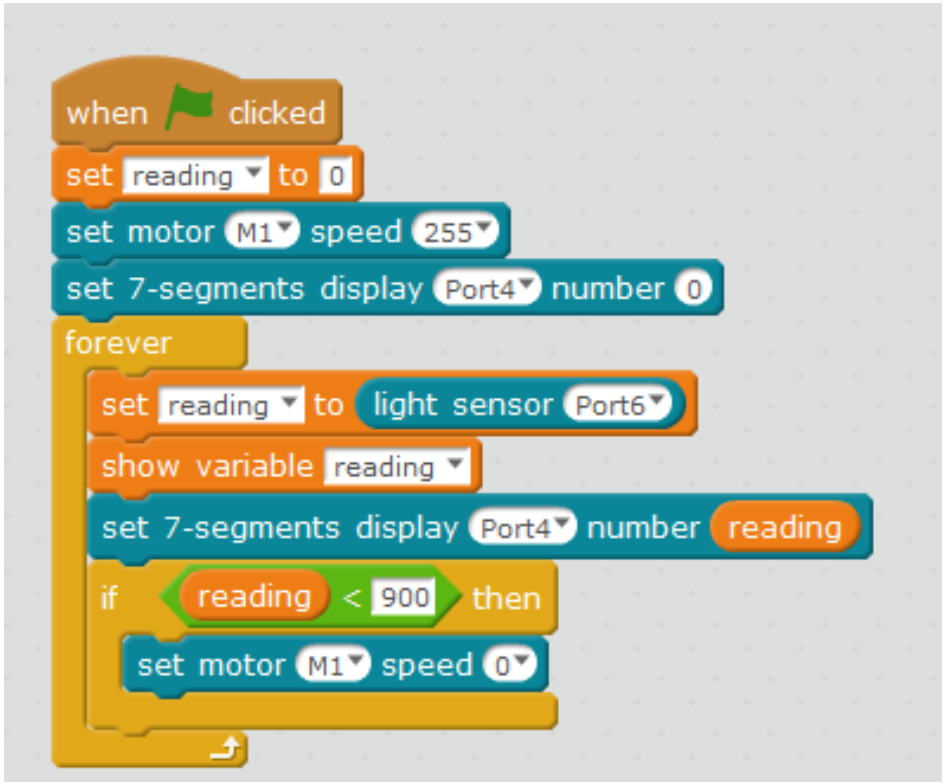
Proof of Concept Light Curtain Block Diagram



mBlock (VPL)Visual Programming Language…

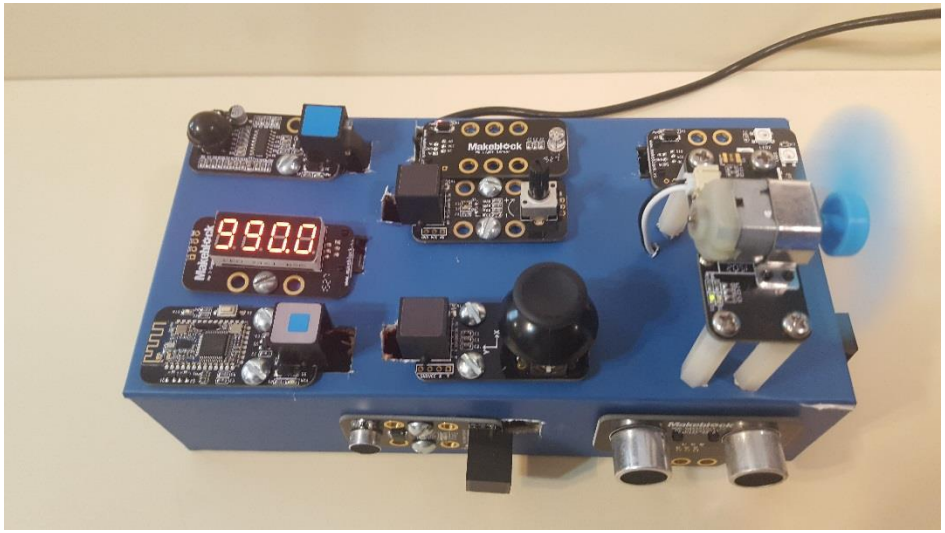


Project Code: **Light Sensor Light Curtain: Safety Controls**

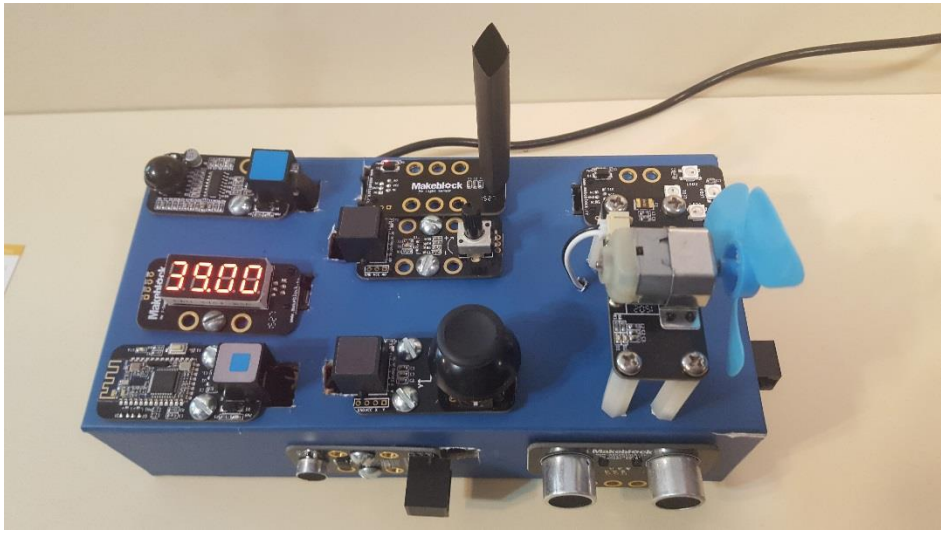


Hands-On Project: Safety Controls…

Functional Concept Design:



No object detected, dc motor ON:
Ambient Light



Object detected, dc motor OFF:
Light interrupted

Question 5

Using the mBlock VPL code on slide 32, write the conditional statement that checks the Me Light Sensor's light level.