Pearson BTEC Levels 4 Higher Nationals in Engineering (RQF)

Unit 6: Mechatronics

Unit Workbook 2

in a series of 4 for this unit

Learning Outcome 2

Mechatronic System Specification

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INTRODUCTION

Design a mechatronic system specification for a given application

Systems specifications:

British and/or European standards relevant to application

Sensor types and interfacing

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Selection and use of appropriate control software/devices.

Consideration of the interaction of system variables

System commissioning parameters

BS EN 60947 Parts 1-8	2001 - 2011	Specification for low voltage switch gear and control gear

Electrical Appliances

Standard	Year	Description
BS 1362	1973	Specification for general purpose fuse links for domestic and similar purposes (primarily for use in plugs)
BS 1363 Parts 1 -5	1995 - 2008	13 A plugs, socket-outlets and adaptors.
BS EN (IEC) 60309, Parts 1,2, 4	1999 - 2007	Plugs, socket-outlets and couplers for industrial purposes.
BS EN 60320, Parts 1, 2	1999 - 2009	Appliance couplers for household and similar general purposes.
BS EN 60335, Many parts		Specification for safety of household and similar electrical appliances

Electromagnetic Compatibility

Standard	Year	Description
BS EN 61000-6-3,4	2007 - 2011	Electromagnetic compatibility. Generic emission standard.
BS EN 61000-6-1,2	2005 - 2007	Electromagnetic compatibility. Generic immunity standard.
BS EN (IEC) 60801, Part 2	1993	Electromagnetic compatibility for industrial-process measurement and control equipment. Electrostatic discharge requirements

Flammable Atmospheres

Standard	Year	Description
EEMUA 181	1995	Guide to risk-based assessments of in-situ large Ex e & Ex n machines
EEMUA 186	1997	A Practitioners handbook – electrical installation & maintenance in potentially explosive atmospheres
BS EN 1127, Parts 1,2	2007 - 2008	Explosive atmospheres. Explosion prevention and protection. Basic concepts and methodology for mining
PD CLC/TR 50404:	2003	Code of practice for avoidance of hazards due to static electricity.

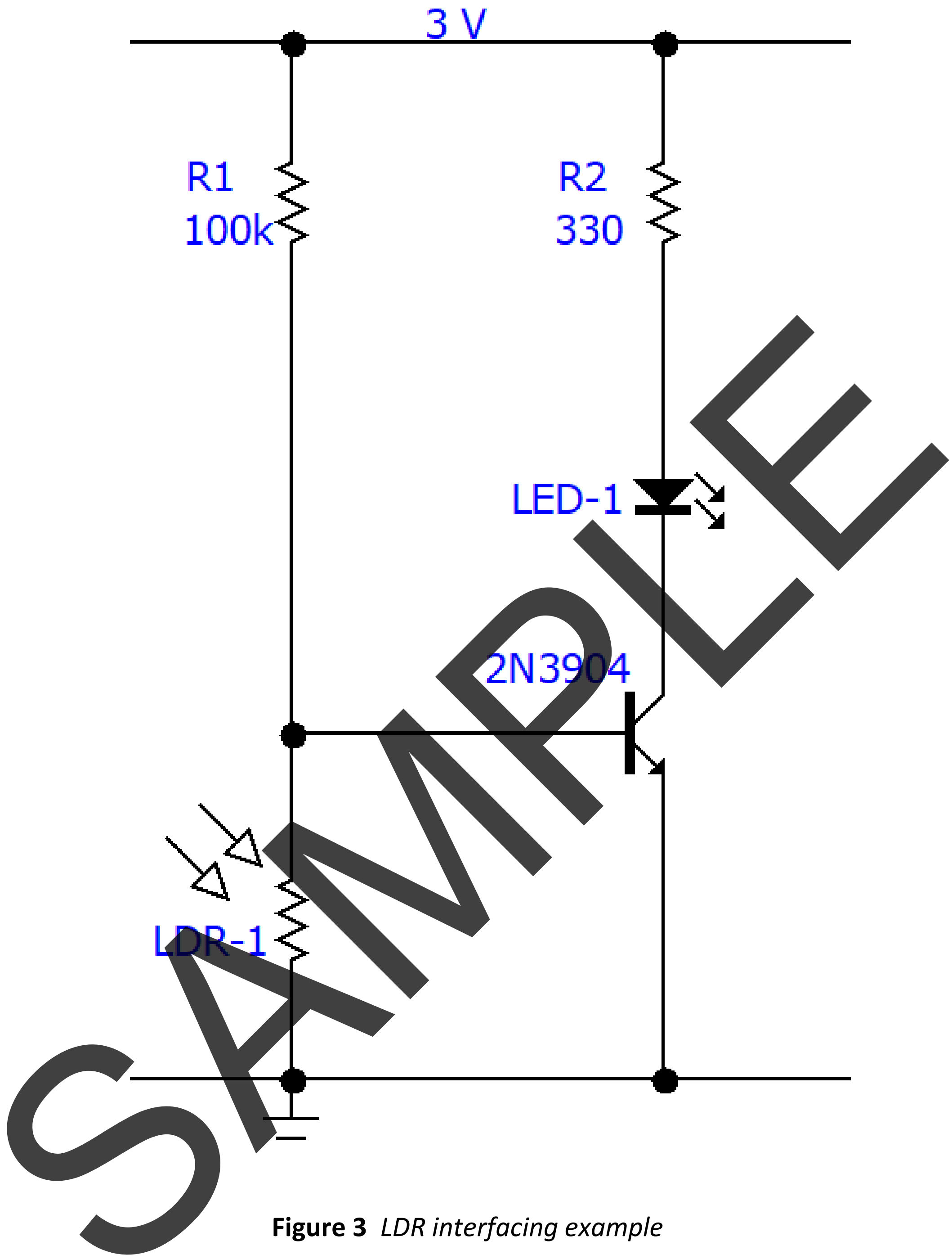

Figure 3 *LDR interfacing example*

In Figure 3 we see the LDR forming the lower section of a potential divider with resistor R1. When the light level is high the resistance of the LDR falls to around 5 kΩ, meaning that the voltage across the LDR is around 0.15 V, which is insufficient to turn on the transistor (this needs a base voltage of 0.7 V to allow a significant collector current to flow). Therefore, since no collector current flows the LED is turned off.

If the ambient light levels fall to darkness, the LDR resistance will go high (typically to around 1 MΩ). In this case the transistor base voltage goes high and the transistor turns on, lighting the LED.

In figure 5 we see that the thermistor forms part of a potential divider with a potentiometer. The potentiometer is useful here because it allows us to set the desired temperature for the relay to trigger. The two BC547B transistors form what is known as a 'Darlington Pair', which effectively act as a single transistor with a very high current gain, therefore able to drive a relay coil, as shown. The purpose of the diode D1 is to absorb large reverse-voltage spikes generated by the relay coil, thus protecting the transistors from damage.

Touch Plate

Figure 6 shows how a touch plate may be interfaced to appropriate circuitry. In this case a 555-timer chip is utilised.

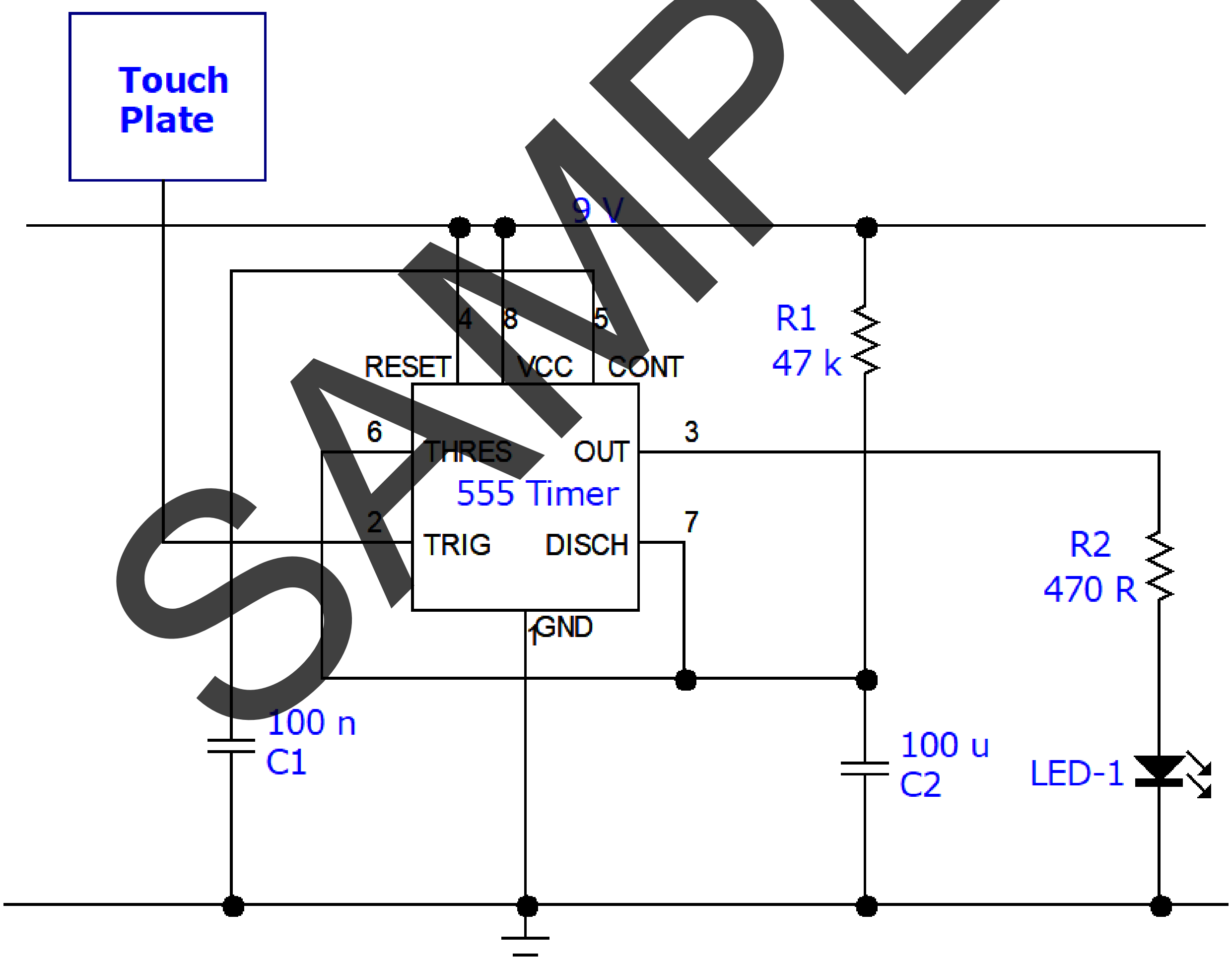

Figure 6 *Touch plate circuit*

soon as this capacitance changes, due to the sudden appearance of an object, so does the capacitance of the oscillator, resulting in a change in current being detected, with a resulting signal being fed via a DC output. The DC output can be made to activate a relay or some other form of actuator.

Many other forms of sensor exist for use in mechatronics. Some were discussed in workbook 1, but a comprehensive list may be found in this hyperlink.

Actuator Technology (availability and selection)

An actuator generally receives a control signal of some type and subsequently causes a mechanism of some type to operate, causing movement (or stopping it).

Several actuators were discussed in Workbook 1, but there are many other types of actuator, including;

- Hydraulic
- Pneumatic
- Piezoelectric
- Cam
- MEMS (microelectromechanical systems)
- Plasma
- Valve

There are many sites on the internet which sell actuators. Some of the larger sources are;

RS Components

Farnell

RapidOnline

The selection of an actuator will depend upon a number of factors, and may include:

- Cost
- Size
- Weight
- Temperature
- Humidity
- Vibration
- Electromagnetic interference
- Environmental acidity
- Reliability
- Repeatability
- Noise generation
- Power consumption

In most systems a microcontroller tends to be the device of choice. This type of chip can be implemented in large industrial robots or small household devices (like toasters, food processors). For a selection of popular microcontroller manufacturers and associated programming platforms, see;

Microchip

Texas Instruments

ST Microelectronics

Silicon Labs

Fujitsu

Consideration of the interaction of system variables

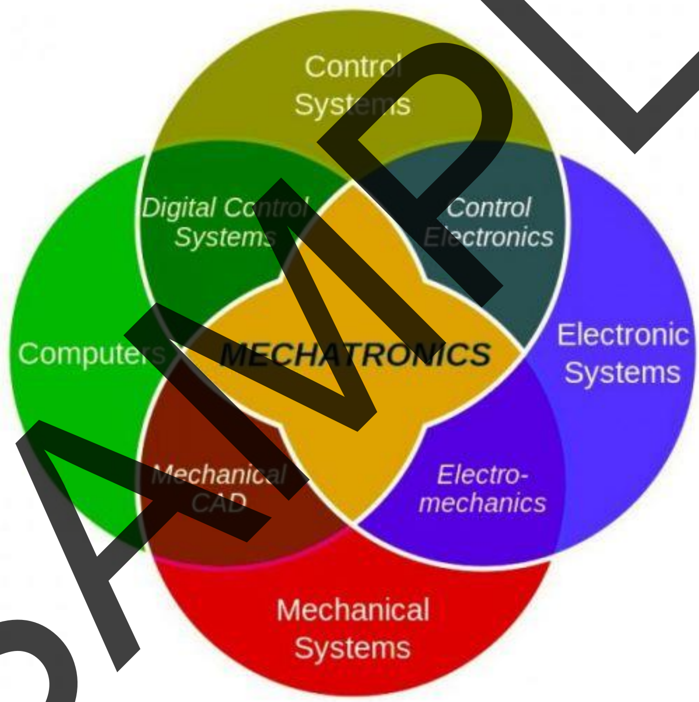

Figure 9 *Interaction of sub-systems in mechatronics*

As seen in figure 9, there are a number of sub-systems which contribute to an overall mechatronic system. Each sub-system will have one or more variables. Examples of such variables might be;

- Water temperature
- Gas pressure
- Supply voltage (dip in grid)