MG7101 ENGINEERING DEVELOPMENT PROJECT

DEVELOPMENT OF COLOUR RECOGNITION SENSOR

Sean English

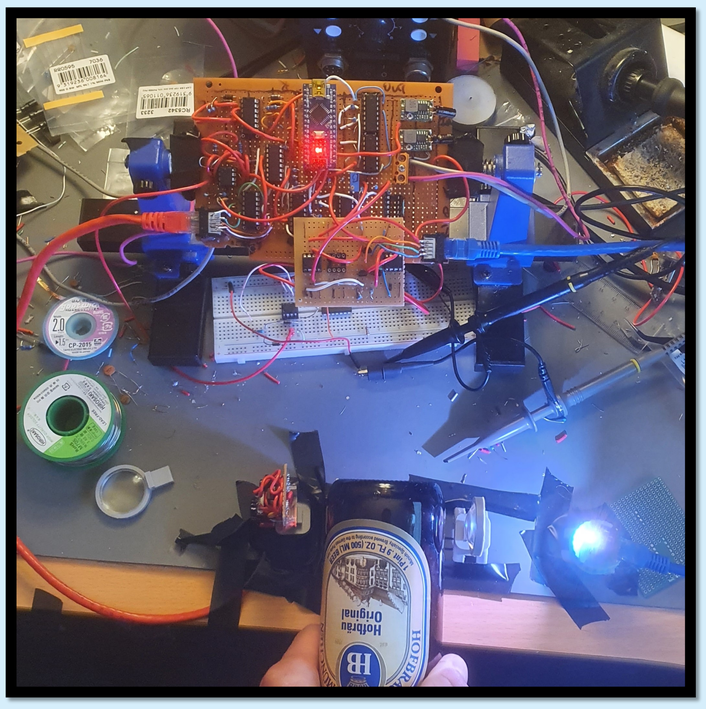
Otago Polytechnic, School of Architecture, Building and Engineering, Dunedin

THE PROBLEM

Develop a method for accurately detecting the colour of an empty glass bottle as part of an autonomous glass recycling bottle bank.

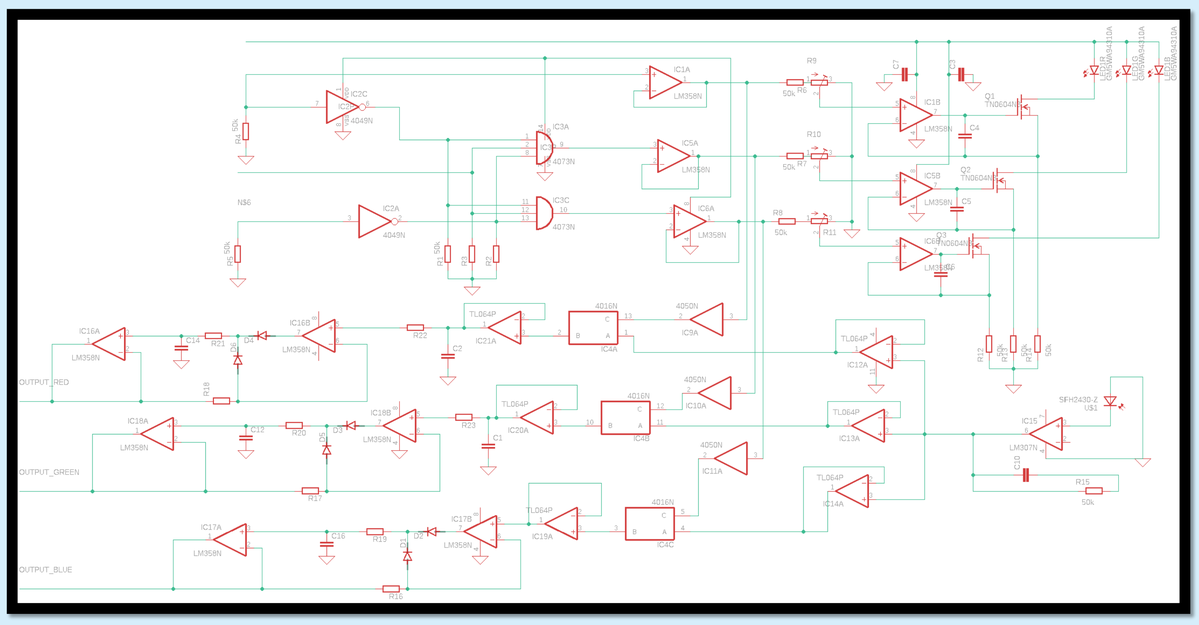
THE SOLUTION

Development of a basic spectrophotometer to be used as a colour recognition sensor. It works by passing modulated monochromatic light at wavelengths 619-624nm, 520-540nm and 460-480nm from an LED (the source) through the bottle under test (BUT) and on to an adjacent silicone photodiode (the detector). The signal produced by the photodiode is demodulated and measured by a micro controller. Each of the 3 wavelengths that make up the source are attenuated at different rates depending on the colour of the BUT. The colour of the BUT can be deduced by comparing the ratio of attenuated light across the wavelengths.

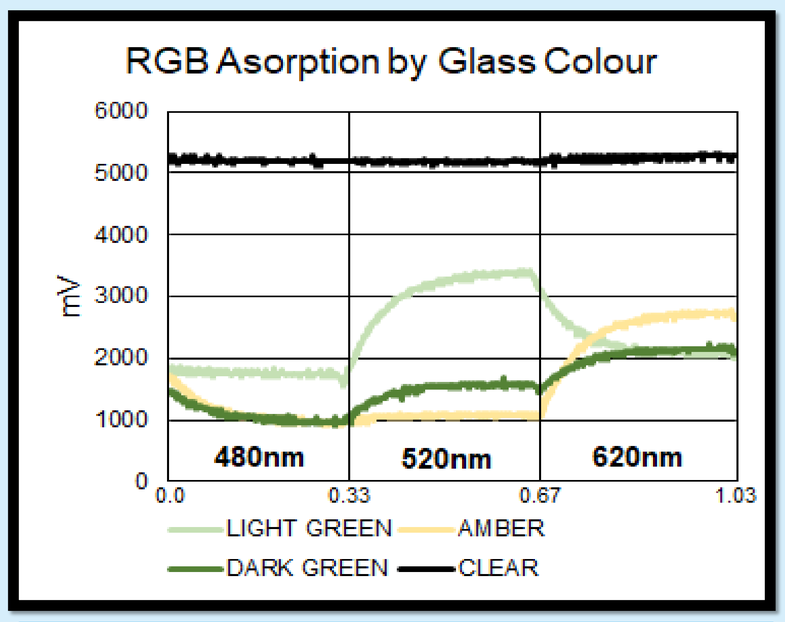


THE FINISHED PROTOTYPE

An Arduino Microcontroller outputs 2 Pulse Width Modulated (PWM) voltage signals with a duty cycle of 1/3 and 2/3 at 975Hz, this is then converted by the modulating circuit to 3 PWM signals with duty cycles of 1/3 at 975Hz. A modulating circuit drives the Current sink for the RGB LED via an op-amp buffer and provides the logic input for the demodulating IC. The Current Sink converts the PWM voltage output from the Modulating Circuit into a PWM current to drive the RGB LED, the LED emits light in wavelengths of 620nm (R), 520nm (G), and 480nm (B). It is focused through a lens and passes through the Bottle Under Test (BUT) the passing light through the BUT is measured by a detector circuit which consists of a Photodiode and an Op-Amp, the detector circuit outputs a single continuous voltage signal made up of data from the 3 wavelengths. From the detector circuit the signal is buffered and demodulated with a CMOS analog switch, the demodulator chops the constant voltage signal into 3 pulsed signals each containing the data from 1 of the 3 wavelengths passed through the BUT. The pulsed signals are conditioned by a lowpass filter to smooth the peaks of the pulse and then converted by the Peak Detector circuit into 3 dc voltage signals with an amplitude equal to the peak of the pulse. The dc values are measured by an Arduino microcontroller and the colour of the BUT can be determined in software.



Schematic of the sensor circuit



Detector voltage output,
showing light attenuation vs bottle colour.

THE FUTURE

It requires some tidy-up programming and inclusion of 3D printed parts to take this from a benchtop protype to used in a real-world situation. Also I would like to create a PCB version with SMD components. I hope to have this completed over summer for the sensor to be incorporated into the bottle bank. Cheers

CONTACT

Matt King, Senior Lecturer – Electrical
E-mail: matt.king@op.ac.nz

BEng Technology ELECTRICAL
School of Architecture, Building and Engineering
OTAGO POLYTECHNIC DUNEDIN NEW ZEALAND

SEAN ENGLISH