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E344 Assignment 1

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Report submitted in partial fulfilment of the requirements of the module Design (E) 344 for the degree Baccalaureus in Engineering in the Department of Electrical and Electronic Engineering at Stellenbosch University.

August 8, 2020

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   Plagiarism is the use of ideas, material and other intellectual property of another's work and to present is as my own.

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   I declare that the work contained in this assignment, except where otherwise stated, is my original work and that I have not previously (in its entirety or in part) submitted it for grading in this module/assignment or another module/assignment.

21745102 Studentenommer / *Student number*	Egor Handtekening / *Signature*
E.S Cishugi Voorletters en van / *Initials and surname*	August 8, 2020 Datum / *Date*

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Nomenclature

Variables and functions

$p(x)$	Probability density function with respect to variable x.
$P(A)$	Probability of event A occurring.
ε	The Bayes error.
ε_u	The Bhattacharyya bound.
B	The Bhattacharyya distance.
s	An HMM state. A subscript is used to refer to a particular state, e.g. s_i refers to the i^{th} state of an HMM.
$\mathbf{S}$	A set of HMM states.
$\mathbf{F}$	A set of frames.
$\mathbf{o}_f$	Observation (feature) vector associated with frame f.
$\gamma_s(\mathbf{o}_f)$	A posteriori probability of the observation vector $\mathbf{o}_f$ being generated by HMM state s.
μ	Statistical mean vector.
Σ	Statistical covariance matrix.
$L(\mathbf{S})$	Log likelihood of the set of HMM states $\mathbf{S}$ generating the training set observation vectors assigned to the states in that set.
$\mathcal{N}(\mathbf{x}\|\mu, \Sigma)$	Multivariate Gaussian PDF with mean μ and covariance matrix Σ.
a_{ij}	The probability of a transition from HMM state s_i to state s_j.
N	Total number of frames or number of tokens, depending on the context.
D	Number of deletion errors.
I	Number of insertion errors.
S	Number of substitution errors.

Acronyms and abbreviations

AE	Afrikaans English
AID	accent identification
ASR	automatic speech recognition
AST	African Speech Technology
CE	Cape Flats English
DCD	dialect-context-dependent
DNN	deep neural network
G2P	grapheme-to-phoneme
GMM	Gaussian mixture model
HMM	hidden Markov model
HTK	Hidden Markov Model Toolkit
IE	Indian South African English
IPA	International Phonetic Alphabet
LM	language model
LMS	language model scaling factor
MFCC	Mel-frequency cepstral coefficient
MLLR	maximum likelihood linear regression
OOV	out-of-vocabulary
PD	pronunciation dictionary
PDF	probability density function
SAE	South African English
SAMPA	Speech Assessment Methods Phonetic Alphabet

Chapter 1

System design

1.1. System overview

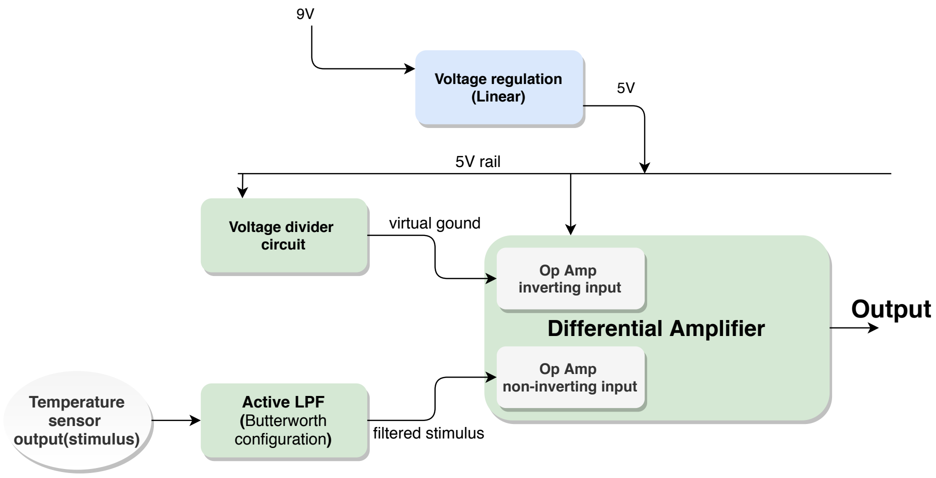


Figure 1.1: System diagram

The purpose of this design is to implement a signal conditioning circuit for an analogue temperature sensor. The **voltage regulator** shall provide a regulated 5V supply to the circuit from a nominal 9V power. An Op Amp circuit in a **differential amplifier** configuration is used: It provides a gain and removes a dc offset from the sensor output(stimulus) and thus, amplifies it from millivolts to volts while staying in the recommended output voltage range. In order to remove the dc offset from the stimulus and establish a virtual ground, given that only a positive voltage rail shall be used to power the Op Amp, a **voltage divider**(a resistors circuit) is used. Before feeding the stimulus to the amplifier, an **active low-pass filter** in the Butterworth configuration is used. The filter shall suppress noise from the stimulus by attenuating components at 50Hz and above.

1.2. Rationale

A linear regulator was chosen over a switching mode regulator due to the low noise levels on its output despite the switching regulator being more power efficient than the linear one. A second order Butterworth low-pass filter has high accuracy, low noise levels, relatively short settling time and a sharp drop-off gradient after the cut-off frequency(approximately 40db/dec): these characteristics make it an ideal choice for a filter given that noise need to be suppressed from the stimulus at 50Hz without attenuating the dc components.

Chapter 2

Voltage regulation

2.1. Introduction

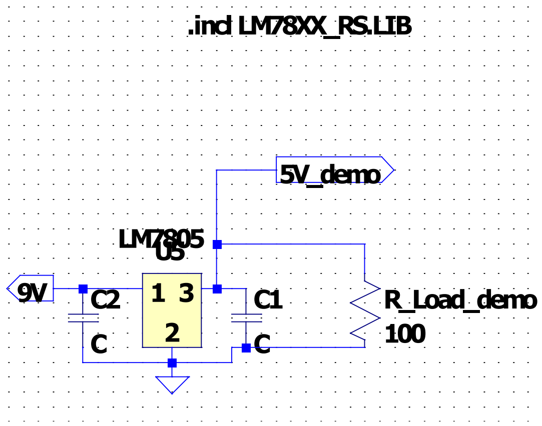
Introduce the reader to what you want to present in this chapter. Include any references to literature you feel is needed. In this section, you put a very short summary of infrormation you gatherered from literature (papers, web sites, datasheets) that you used to do the design. Be sure to include the references, which you can add in the `References.bib` file.

Some examples of how to cite (all in `References.bib`): It was stated by [1] that ... . Subsequently, he changed his mind and said in [2] that ... . While [3] claims it to be ... .

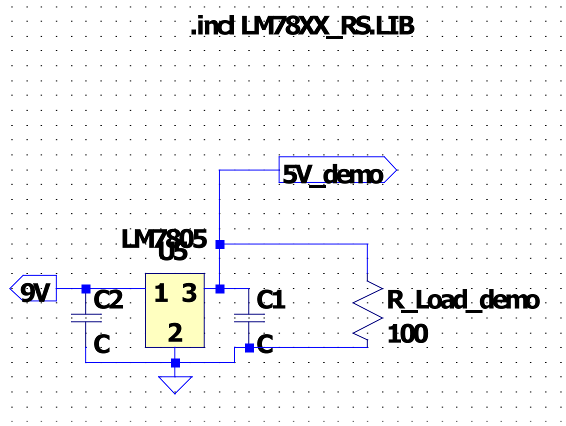
2.2. Design

In this section, you need to capture your design, which should include the following:

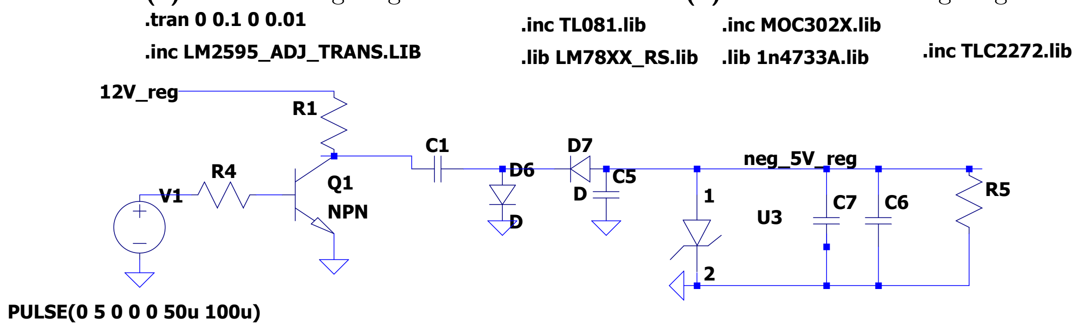
- Design rationale, i.e. what your thinking was behind the design.
- References to literature/sources as appropriate [3].
- You can assume the reader has an E&E degree, and will not need detail explanations of trivial information (e.g. what a resistor is, or what Ohm's law is).
- Design calculations, for example to determine resistor values and capacitor values, or to check for allowed voltage and current ranges and levels. These calculations should also give expected outputs, which hopefully matches the simulated values.
- Analysis of given or expected input conditions.
- Expected values and ranges based on your design.
- Explain your choice of supply buy referring to the advantages and disadvantages of each.
- Circuit diagram like the one in Figure 2.1. I used "print to PDF" from LTSpice, but feel free to use a cropped screengrab if you are PDF-challenged and do not have a PDF printer (there are some free PDF creators online). Also have a look at the demo video on SUNLearn.



(a) Linear voltage regulator.



(b) Switchmode voltage regulator.



(c) Chargepump voltage regulator.

Figure 2.1: Circuit diagrams of the two voltage regulators, and another irrelevant one
.

For your benefit, here is how to write values with units: 150 mΩ or 199 myUnits, and this is how we write ranges: 2 to 5 kV.

Here is an inline equation $\frac{55}{45+3}$. Here is a numbered equation in Eq. 2.1.

$$a = \frac{55}{45+3}. \tag{2.1}$$

.

2.3. Results

In this section, you want to demonstrate, by means of referring to simulation results, using the designed circuit, how your circuit behaves as you designed it in Section 2.2. Present and report on your simulated results in Figure 2.2 Be absolutely sure that the text and information in your report are readable.

You can use screengrabs or photos of the oscilloscope, or download the CSVs and plot them as PDFs using Matlab, Excel or similar. You can also use tables, example of which are presented in Tables 2.1 and 2.2.

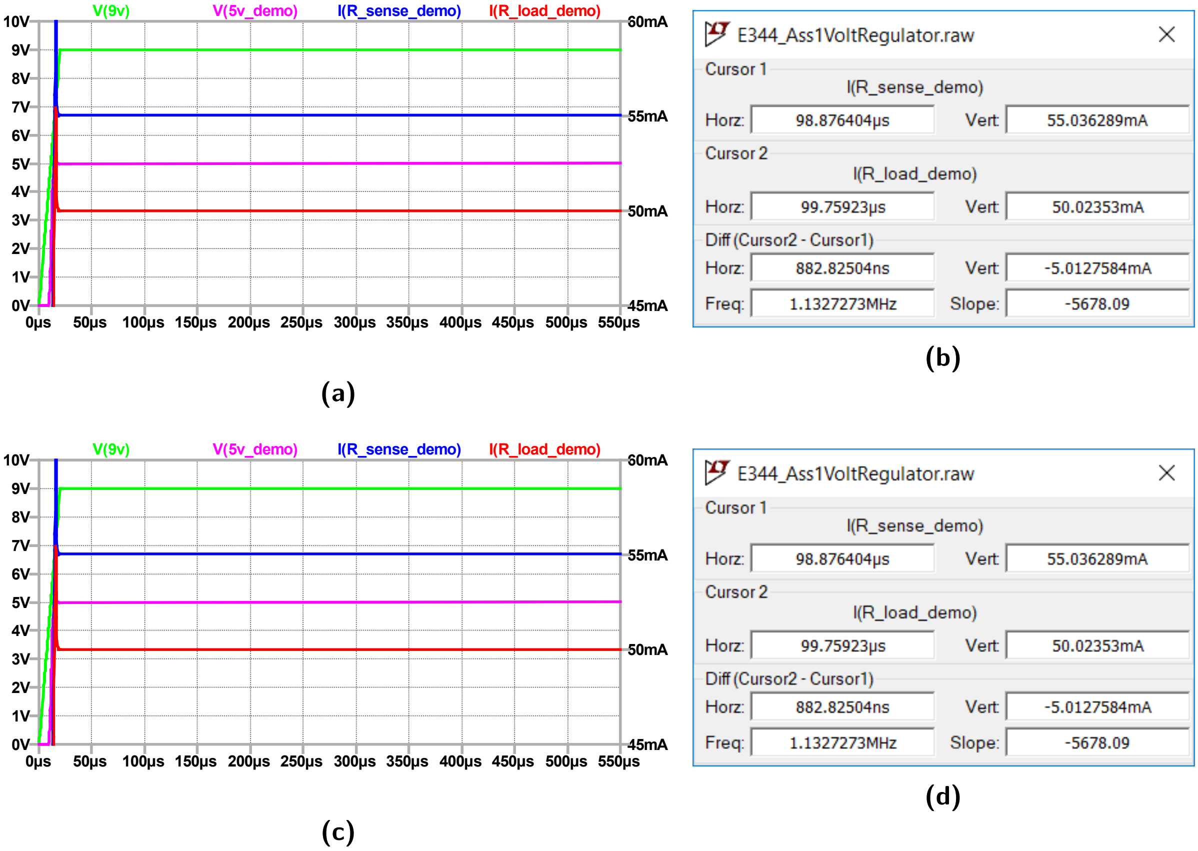


Figure 2.2: Voltage regulation, comparing the linear and switchmode regulators... (a) Blah blah. (b) Blah blah. (c) Blah blah. (d) Blah blah. As far as possible, please put input(s) and output(s) on the same plot rather than on separate plots. Based on the datasheet of XXXX in [3]

Table 2.1: Example of a simple table.

	2017	2018	Δ_{Abs}	Δ_{DiD}
A	9,868	10,399	+5	-11
B	10,191	10,590	+4	-12

Table 2.2: Example of another table.

Schools	Total energy used		Change	
	2017 [kWh]	2018 [kWh]	Δ_{Abs} [%]	Δ_{DiD} [%]
A	9,868	10,399	+5	-11
B	10,191	10,590	+4	-12

2.4. Summary

State whether your design performs as expected and what the limitations are or things to keep in mind are.

Chapter 3

Temperature sensor conditioning circuit

3.1. Intro

3.2. Design

3.3. Results

3.4. Summary

Chapter 4

System and conclusion

4.1. System

Report on the integration of the voltage regulator and temperature sensing circuitry. Report on noise levels and how the temperature sensor will fit into the system (E.g. what the calibration will look like and what the the measurement error will be given the range, quantisation error and noise).

4.2. Lessons learnt

Write down at least three of the most important things you have learnt in Assignment 1.

Bibliography

[1] M. J. Booysen, S. J. Andersen, and A. S. Zeeman, "Informal public transport in Sub-Saharan Africa as a vessel for novel Intelligent Transport Systems," in *16th International IEEE Conference on Intelligent Transportation Systems (ITSC 2013)*, Oct 2013, pp. 767–772.

[2] S. Gerber, A. J. Rix, and M. J. Booysen, "Combining grid-tied PV and intelligent water heater control to reduce the energy costs at schools in South Africa," *Energy for Sustainable Development*, vol. 50, pp. 117 – 125, 2019.

[3] BBC, "How to make opamps amp op," 2018. [Online]. Available: www.electronics-tutorials.ws

Appendix A

Social contract

Sign and inlcude.

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E-design 344 Social Contract

2020

The purpose of this document is to establish commitment between the student and the organisers of E344. Beyond the commitment made here, it is not binding.

In the months preceeding the term, the lecturer (Thinus Booysen) and the Teaching Assistant (Michael Ritchie) spent countless hours to prepare for E344 to ensure that you get your money's worth and that you are enabled to learn from the module and demonstrate and be assessed on your skills. We commit to prepare for the module, to set the tests and assessments fairly, to be reasonably available, and to provide feedback and support as best and fast we can. We will work hard to give you the best opportunity to learn from and pass analogue electronic design E344.

Signature: .... Date: 13 July 2020 ....

....

I, ... have registered for E344 of my own volition with the intention to learn of and be assessed on the principals of analogue electronic design. Despite the potential publication of supplementary videos on specific topics, I acknowledge that I am expected to attend the lectures and lab sessions to make the most of these appointments and learning opportunities. Moreover, I realise I am expected to spend the additional requisite number of hours on E344 as specified in the yearbook.

I acknowledge that E344 is an important part of my journey to becoming a professional engineer, and that my conduct should be reflective thereof. This includes doing and submitting my own work, working hard, starting on time, and assimilating as much information as possible. It also includes showing respect towards the University's equipment, staff, and their time.

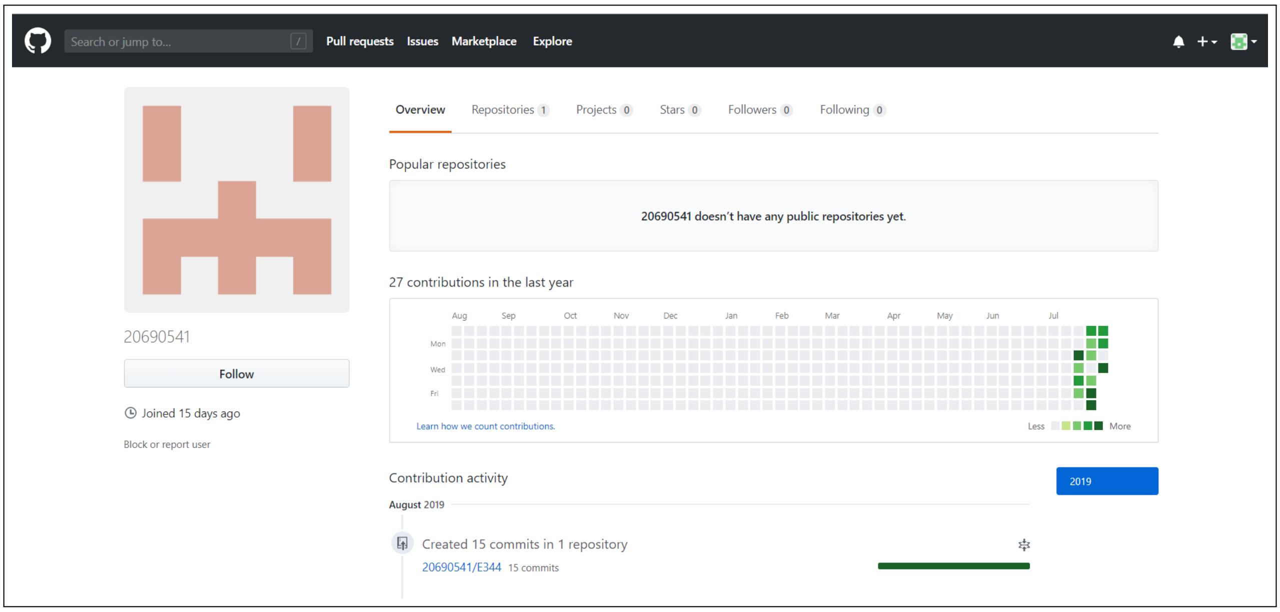
Signature: .... Date: ....

1

Appendix B

GitHub Activity Heatmap

Take a screenshot of your github version control activity heatmap and insert here.



Appendix C

Stuff you want to include

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