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E344 Assignment 3

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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.

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E. Stewdent Voorletters en van / *Initials and surname*	August 28, 2021 Datum / *Date*

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Nomenclature

Update this list to make it applicable to your project.

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

Update this list to make it applicable to your project.

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

Fuse

1.1. Literature

General Info:
A fuse is an electrical device that is use for saftety purposes in order to protect against overcurrent. It consists of a metal wire or strip that conducts current, but melts when too much current flows through it, thus disconnecting the circuit and stopping current from flowing between the two points where the fuse was connected. Fuses are rated according to a maximum continuous current that the fuse can conduct without melting. There are two major rating standards IEC) and UL standards give acronyms?do I even put this in?. The fuse also has a maximum voltage rating, which needs to be greater than what would become open circuit (OC) voltage, otherwise an arc may occur. Fuse ratings change according to the operational temperature of the enclosure or area in which the fuse is situated. The fuse is then re-rated according to a re-rating curve of rated current vs ambient temperature. add figure and reference. The time it will take for a fuse to blow is determined by it's time-current characteristics as shown in figure reference fig and add**??**. Thus, if the ambient temperature is higher the fuses's rated current is lower and thus will require less time to blow.

Briefly summarise all the information you have gathered that was necessary to choose an appropriate fuse. This section is aimed at someone at your level of knowledge (the median E&E third year student).

1.2. Design

Put in calculations, assumptions, analysis, choice. This is an example of design by analysis, where we will not be testing it, since the test is destructive.

The load which our battery will have to power will consist of 5 ultra-bright LEDS add acronym, which will each be limited to draw 20mA by a current-limiting resistor. We will also allow for 50mA of headroom in order to power some other things in our circuit like the 5V voltage regulator. The maximum current that will enter our battery is during charging which is designed as $400mA$ and is thus the maximum current our fuse should be able to continuously handle.

Fuses should only be operated at around 75% of their rated value cite littlefuses fuseology pdf []. Our fuse will typically operate in an enclosure which will be in direct sunlight, thus we need to take temperature rerating into account. Assuming an ambient temperature of 45°C, our fuse has a temperature rerating factor of around 97% []. The fuse which we should use to protect the battery can thus be calculated as:

$$Ideal\ Fuse\ Rating = \frac{Nominal\ Operating\ Current}{Temp\ Rerating\ Factor \times 0.75}$$
$$Ideal\ Fuse\ Rating = \frac{400mA}{0.97 \times 0.75}$$
$$Ideal\ Fuse\ Rating = 0.55A$$

The next available fuse size should therefore be chosen, thus we will pick a 1A fuse.

If something goes wrong and there is a short circuit and the battery discharges 10A or more through the load the fuse will break in 0.01s as seen in figure **??**, thus protecting the circuit from damage.

Chapter 2

Undervoltage battery protection

This chapter answers the question: "Did the student follow a systematic approach to design the sought solution?". You therefore need to follow a systematic/logic path, and did you clearly communicate it.

2.1. Literature

Here you can include stuff you learnt that you will use in the design - e.g. operational amplifiers as comparators, hysteresis, rail-to-rail comparators. If you feel there was nothing you had to learn to do this, feel free to leave this section out.

2.2. Overview

Explain your undervoltage circuit layout and functional-level choice of component types. Include the high-side switch configuration and opamp location in the circuit. You do not want to give any detail of the design, like resistors and capacitor values, just an overview of how your undervoltage circuit "hangs together" - similar to that part of the diagram in the Project Overview file provided. You will probably use a block diagram here (if you have space) and describe in in text.

2.3. 5V rail

Here explain your selection of 5V regulator.

2.4. High-side switch

Here you describe the design choices made for the switch (Note, this is not the switch we use to control the LM317 output, it is similar switch that controls the supply from the battery to the same regulated line, but it does not have a blocking diode).

2.5. Voltage monitoring with hysteresis design

Explain your design of the comparator with hysteresis, taking into account things like common mode voltages, differential voltages, input-to-rail voltages, hysteresis deadband, resistor values and current consumption, etc.

2.6. Circuit diagram

Show your circuit diagram (the one you will submit). Ensure that it is of good quality, and preferably a vector (metadata) plot, not a raster (pixel) plot, so you can zoom in and select text from it.

2.7. Results

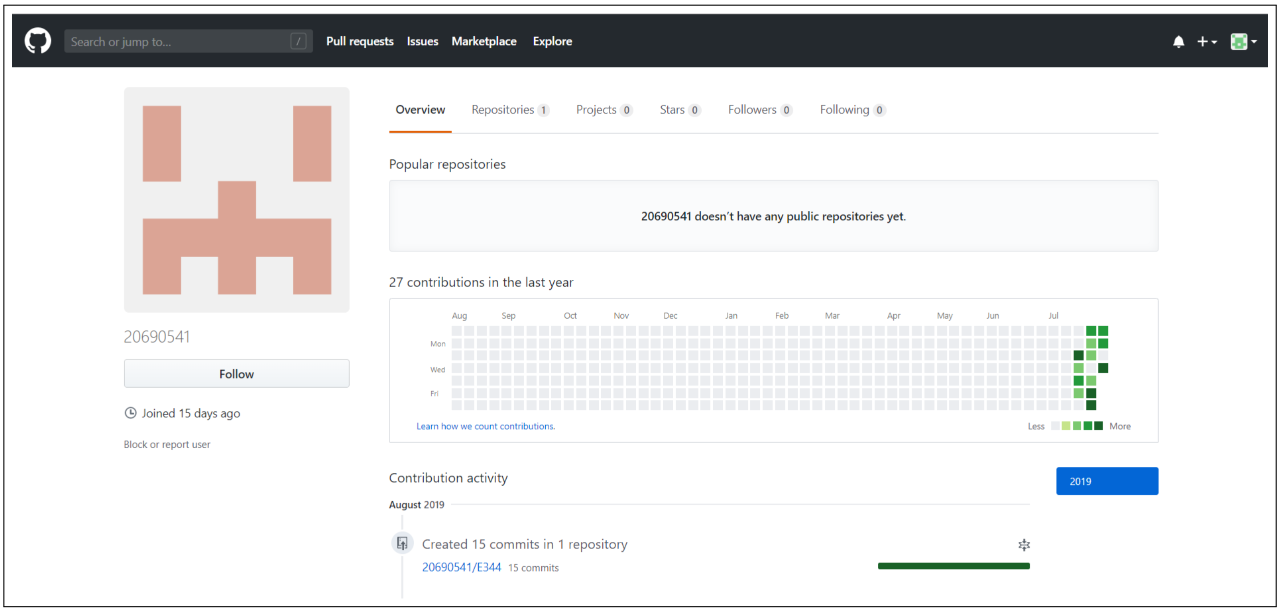
Here you include your simulation results and your measured results. For the measured results, it would be most beneficial to show on the same oscilloscope screen-grab (or CSV plot), how the switch went through the stages of the hysteresis loop (similar to what you had to do for the video). You are welcome to use subplots to save space.

Bibliography

Appendix A

GitHub Activity Heatmap

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



Appendix B

Stuff you want to include

remove this!!

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