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E344 Assignment 4

Tasin Islam

23142251

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.

September 6, 2021

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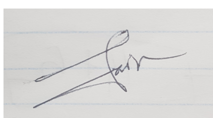
23142251 Studentenommer / *Student number*	 Handtekening / *Signature*
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Nomenclature

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

Low-side load control

1.1. Literature

The objective of the assignment is to design a load which can be obtained by connecting five bright LEDs in parallel with each other. Here, each LEDs must be designed to draw exactly 20mA of current and therefore the parallel connection of 100mA ensures that each the current splits into five equal paths.

1.2. Design

The maximum operating voltage of the battery is 7.2V. Since we are connecting five LEDs in parallel the voltag eof 7.2V remains constant accross all the LEDs. However, the current through each LEDs must be 20mA. Therefore, we can determine the resistor values for each LED from ohm's law.

$$R = V/I$$

V$_{bat} = 7.2V$
$V_{led} = 3.2V$
$V_{out} = V_{bat} - V_{led}$

$$V_{out} = 7.2 - 3.2 = 4.0V$$

$$R_{led} = 4.0V/20mA = 200\Omega$$

1.3. Results

Refer to Figure 1

Chapter 2

Bidirectional current measurement

2.1. Overview

Bidirectional current can be obtained from making use of TSC213 current sense amplifier. Voltage division from 5V regulated will provide us with the reference voltage. We will connect the diode's negative terminal at the Vin-, which will be connected to the drain of the PMOS of the overcharging circuit and the diode's positive terminal at the Vin+ output of the high side switch.

2.2. Design

We need design a capacitor that will be placed between the TSC output and ground and this is to reduce the ripple voltage on the output voltage thus minimising the noise. The capacitance is determined using the formula,

$$f = 1/2\pi R_C$$

To get the required voltage reference of the TSC we ought to design a voltage input that accounts for the minimum discharging current of -150mA and the maximum charging current of 450mA.Since we are designing for an output voltage of the range of 0V to 5, we need to choose 1V to 5V as the range of operation. This is to ensure that out voltage range is as far off the rails of 0V and 5V as possible. Hence, 1V corresponds to the discharging current of -150mA and 4V corresponds to the 450mA of the charging current. Now, we can find the reference voltage using the formula,

$$V_{out} = R_{shunt} * I_{load} * Gain + V_{ref}$$

[1] According to the data sheet, Gain= 50, Rshunt=0.1 and Vout as we designed is 4V and we can rearrange the equation to determine Vref as follows,

$$V_{ref} = 4 - (0.1 * 0.450) * 50 = 1.75V$$

We need do voltage division on 5V input to split into 1.75V and 3.24V with the resistance ration of 1.75:3.25= 1:1.857. The corresponding resistance values are 210k and 390K. With these resistors we will be able to obtain our required output voltage of at least 2.5V.

2.3. Simulation

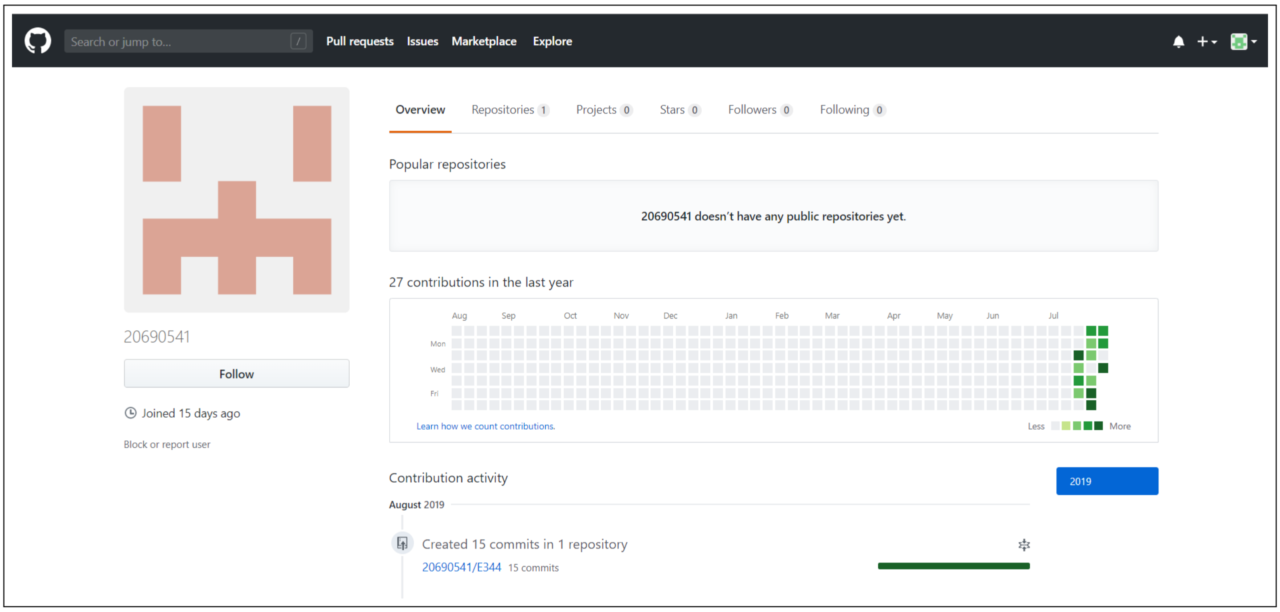
Bibliography

[1] Sunlearn, "Tsc210, tsc212, tsc213," 2020. [Online]. Available: https://learn.sun.ac.za/pluginfile.php/2876544/mod_resource/content/0/TSC213.pdf

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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