



DAFTAR ISI

HALAMAN PENGESAHAN	III
PERNYATAAN BEBAS PLAGIASI	IV
KATA PENGANTAR	V
DAFTAR TABEL	X
DAFTAR GAMBAR	XI
INTISARI	XIII
ABSTRACT	XIV
BAB I PENDAHULUAN	1
1.1 LATAR BELAKANG	1
1.2 RUMUSAN MASALAH	3
1.3 BATASAN MASALAH	3
1.4 TUJUAN PENELITIAN	4
1.5 MANFAAT PENELITIAN	4
1.6 SISTEMATIKA PENULISAN	4
BAB II TINJAUAN PUSTAKA	5
BAB III LANDASAN TEORI	11
3.1 GAS	11
3.1.1 <i>Liquefield petroleum gas (LPG)</i>	12
3.1.2 <i>Karbon Monoksida (CO)</i>	12
3.2 INDEKS STANDAR PENCEMARAN UDARA (ISPU)	13
3.3 ELECTRONIC NOSE (E-NOSE)	15
3.4 <i>GAS SENSOR ARRAY</i>	15
3.4.1 <i>Sensor MQ2</i>	16
3.4.2 <i>Sensor MQ7</i>	17
3.4.3 <i>Sensor MQ6</i>	19
3.4.4 <i>Sensor MQ9</i>	20
3.5 ARDUINO NANO	21
3.6 DATA SPASIAL DAN DATA BERURUTAN	23
3.7 CONVOLUTIONAL NEURAL NETWORK (CNN)	23
3.7.1 <i>Lapisan Konvolusi (Convolution)</i>	24
3.7.2 <i>Lapisan Pooling</i>	25
3.7.3 <i>Lapisan Fully Connected</i>	26
3.8 RECURRENT NEURAL NETWORK (RNN)	26
3.9 LONG SHORT-TERM MEMORY (LSTM)	28
3.10 GATED RECURRENT UNIT (GRU)	29
3.11 SUPPORT VECTOR MACHINE (SVM)	29
3.12 MULTI LAYER PERCEPTRON (MLP)	31
3.13 EVALUASI MODEL	32
BAB IV METODE PENELITIAN	35



4.1	TAHAPAN PENELITIAN	35
4.2	STUDI LITERATUR	37
4.3	PERANCANGAN PERANGKAT KERAS	37
4.4	ALAT DAN BAHAN	38
4.5	AKUISISI DATA	38
4.6	PRA-PENGOLAHAN DATA	39
4.7	PERANCANGAN MODEL.....	39
4.8	EVALUASI MODEL	42
4.9	PERBANDINGAN MODEL.....	42
	BAB V IMPLEMENTASI.....	42
5.1	IMPLEMENTASI PERANGKAT KERAS.....	42
5.2	IMPLEMENTASI AKUISISI DATA.....	42
5.2.1	<i>Penyesuaian Ruang Kerja Sensor Gas.....</i>	42
5.2.2	<i>Kode Program Akuisisi Data</i>	43
5.2.3	<i>Penentuan Kelas Data Pembacaan Sensor.....</i>	48
5.3	IMPLEMENTASI PRA-PENGOLAHAN	49
5.4	IMPLEMENTASI PERANCANGAN MODEL ARSITEKTUR.....	51
5.4.1	<i>Gated Recurrent Unit (GRU)</i>	51
5.4.2	<i>Long Short-Term Memory (LSTM)</i>	52
5.4.3	<i>Convolutional Neural Network (CNN) + Gated Recurrent Unit (GRU) 52</i>	
5.4.4	<i>Convolutional Neural Network (CNN) + Long Short-Term Memory (LSTM)</i>	53
5.4.5	<i>Convolutional Neural Network (CNN) + Long Short-Term Memory (LSTM) + Gated Recurrent Unit (GRU)</i>	54
5.4.6	<i>Support Vector Machine (SVM) Non-Linear</i>	55
5.4.7	<i>Support Vector Machine (SVM) Linear.....</i>	56
5.4.8	<i>Multilayer Perceptron (MLP)</i>	56
5.5	IMPLEMENTASI PELATIHAN MODEL	56
5.6	IMPLEMENTASI EVALUASI MODEL	57
	BAB VI HASIL DAN PEMBAHASAN.....	58
6.1	AKUISISI DATA	58
6.2	HASIL PRA-PENGOLAHAN	59
6.3	HASIL PERANCANGAN MODEL ARSITEKTUR.....	61
6.3.1	<i>Hasil Perancangan Model Arsitektur Gated Recurrent Unit (GRU) 62</i>	
6.3.2	<i>Hasil Perancangan Model Arsitektur Long Short-Term Memory (LSTM)</i>	63
6.3.3	<i>Hasil Perancangan Model Arsitektur Convolutional Neural Network (CNN) + Gated Recurrent Unit (GRU)</i>	64
6.3.4	<i>Hasil Perancangan Model Arsitektur Convolutional Neural Network (CNN) + Long Short-Term Memory (LSTM)</i>	65



6.3.5 Hasil Perancangan Model Arsitektur Convolutional Neural Network (CNN) + Long Short-Term Memory (LSTM) + Gated Recurrent Unit (GRU)	67
6.3.6 Hasil Perancangan Model Arsitektur Support Vector Machine (SVM) Non-Linear	68
6.3.7 Hasil Perancangan Model Arsitektur Support Vector Machine (SVM) Linear	69
6.3.8 Hasil Perancangan Model Arsitektur Multi Layer Perceptron (MLP) 69	
6.4 HASIL EVALUASI MODEL	70
6.4.1 Hasil Evaluasi Model Arsitektur Gated Recurrent Unit (GRU)	70
6.4.2 Hasil Evaluasi Model Arsitektur Long Short-Term (LSTM)	72
6.4.3 Hasil Evaluasi Model Arsitektur Convolutional Neural Network (CNN) + Gated Recurrent Unit (GRU)	74
6.4.4 Hasil Evaluasi Model Arsitektur Convolutional Neural Network (CNN) + Long Short-Term Memory (LSTM)	75
6.4.5 Hasil Evaluasi Model Arsitektur Convolutional Neural Network (CNN) + Long Short-Term Memory (LSTM) + Gated Recurrent Unit (GRU) 77	
6.4.6 Hasil Evaluasi Model Arsitektur Support Vector Machine (SVM) Non-Linear	79
6.4.7 Hasil Evaluasi Model Arsitektur Support Vector Machine (SVM) Linear 81	
6.4.8 Hasil Evaluasi Model Arsitektur Multi Layer Perceptron (MLP) . 82	
6.5 HASIL PERBANDINGAN PERFORMA MODEL	84
KESIMPULAN	86
7.1 KESIMPULAN	86
7.2 SARAN.....	86
DAFTAR PUSTAKA	88