

DAFTAR ISI

| | |
|--|------|
| LEMBAR PENGESAHAN | ii |
| LEMBAR PERNYATAAN ORISINALITAS | iii |
| ABSTRAK | iv |
| ABSTRACT | v |
| KATA PENGANTAR | vi |
| UCAPAN TERIMA KASIH..... | vii |
| DAFTAR ISI..... | viii |
| DAFTAR GAMBAR | xi |
| DAFTAR TABEL..... | xiii |
| BAB I PENDAHULUAN | 1 |
| 1.1 Latar Belakang Masalah..... | 1 |
| 1.2 Rumusan Masalah | 2 |
| 1.3 Tujuan..... | 2 |
| 1.4 Batasan Masalah..... | 2 |
| 1.5 Metode Penelitian..... | 2 |
| 1.6 Sistematika Penulisan..... | 3 |
| BAB II TINJAUAN PUSTAKA..... | 4 |
| 2.1 Gestur atau Isyarat Tangan..... | 4 |
| 2.2 Robot | 4 |
| 2.2.1 <i>Mobile Robot</i> | 5 |
| 2.3 <i>Computer Vision</i> | 5 |
| 2.4 <i>Open Source Computer Vision (OpenCV)</i> | 5 |
| 2.5 <i>Digital Image Processing</i> | 6 |
| 2.5.1 <i>Grayscale</i> | 6 |
| 2.5.2 <i>Thresholding</i> | 7 |
| 2.6 Jaringan Syaraf Tiruan (<i>Artificial Neural Network</i>)..... | 8 |
| 2.6.1 <i>Forward Pass</i> | 9 |
| 2.6.2 <i>Backward Pass</i> | 9 |
| 2.7 <i>Convolutional Neural Network (CNN)</i> | 10 |

| | |
|--|----|
| 2.7.1 <i>Convolution Layer</i> | 11 |
| 2.7.2 <i>Pooling Layer</i> | 13 |
| 2.7.3 <i>Fully Connected Layer</i> | 14 |
| 2.7.4 Fungsi Aktivasi (<i>Activation Function</i>) | 17 |
| 2.8 Arduino Uno..... | 18 |
| 2.9 Bluetooth | 19 |
| BAB III PERANCANGAN SISTEM | 20 |
| 3.1 Gambaran Umum Sistem | 20 |
| 3.2 Perancangan Perangkat Keras | 22 |
| 3.2.1 Kamera <i>Webcam</i> | 23 |
| 3.2.2 Laptop | 23 |
| 3.2.3 Robot..... | 24 |
| 3.3 Perancangan Perangkat Lunak | 28 |
| 3.3.1 Pengumpulan Data Gambar | 29 |
| 3.3.2 <i>Image Preprocessing</i> | 30 |
| 3.3.3 Desain <i>Convolutional Neural Network</i> | 31 |
| 3.4 Proses <i>Training</i> | 33 |
| 3.5 Proses Penangkapan Gambar secara Langsung..... | 34 |
| 3.6 Pengiriman Sinyal Input dan Pergerakan Robot | 36 |
| BAB IV HASIL PENGUJIAN DAN ANALISA | 38 |
| 4.1 Observasi Parameter <i>Training</i> | 38 |
| 4.1.1 Observasi Besar <i>Learning Rate</i> | 38 |
| 4.1.2 Observasi Jumlah <i>Epoch</i> | 40 |
| 4.2 Observasi terhadap Lingkungan | 42 |
| 4.2.1 Observasi terhadap Intensitas Cahaya | 43 |
| 4.2.2 Observasi terhadap Jarak | 44 |
| 4.2.3 Observasi terhadap Sudut Kemiringan | 44 |
| 4.3 Pengujian Klasifikasi Isyarat Tangan..... | 46 |
| 4.4 Pengujian Perubahan Tegangan Motor | 49 |
| 4.5 Pengujian Respon Waktu | 52 |
| 4.6 Pengujian Pergerakan Robot | 53 |
| BAB V KESIMPULAN DAN SARAN | 57 |

| | |
|----------------------|----|
| 5.1 Kesimpulan..... | 57 |
| 5.2 Saran..... | 57 |
| DAFTAR PUSTAKA | 59 |
| LAMPIRAN..... | 62 |