DAFTAR PUSTAKA

Agustiansyah, A., Ardian, A., Setiawan, K., dan Dewi, E.P. 2021. Pengaruh Lama Pemanasan Basah Dan Perendaman Dalam Giberelin Terhadap Pematahan Dormansi Benih Kelapa Sawit (*Elaeis guineensis* jacq.). Agrin, 24(1): 12. doi:10.20884/1.agrin.2020.24.1.508.

Alzubaidi, L., Zhang, J., Humaidi, A. J., Al-Dujaili, A., Duan, Y., Al-Shamma, O., dan Farhan, L. 2021. Review of deep learning: Concepts, CNN architectures, challenges, applications, future directions. *Journal of Big Data*, *8*(1): 1-74.

Ananto, D.T., Mahardewantoro, D.D., Mustafa, F., Ardianto, M.G., Rafi, M.M., Zein, R.A., Saputra, O.E., Mujiastuti, R., Rosanti, N., and Adharani, Y. 2023. Edukasi dan Pelatihan Pengenalan Machine Learning dan Computer Vision Untuk Mengeksplorasi Potensi Visual. *Prosiding Seminar Nasional Pengabdian Masyarakat LPPM UMJ 1(1).* Available from https://jurnal.umj.ac.id/index.php/semnaskat/article/view/19491 [accessed 14 April 2024].

Andika, B., Fitri Boy, A., Kornelius Sitepu, G., Informasi, S., Triguna Dharma, S., dan Komputer, S. 2023. Volume 6 ; Nomor 2. Juli, 668–677. https://ojs.trigunadharma.ac.id/index.php/jsk/index

Asrianda, A., Aidilof, H.A.K., and Pangestu, Y. 2021. Machine Learning for *Detection* of Palm Oil Leaf Disease Visually using *Convolution*al Neural Network Algorithm. *Journal Of Informatics And Telecommunication Engineering*, 4(2): 286–293. doi:10.31289/jite.v4i2.4185.

Chen, L., et al. (2020). *Optimizing Hyperparameters in Deep Learning Models for Improved Accuracy*. International Journal of Machine Learning and Computing, 9(3), 215-222.

Elidar, Y., and Purwati. 2021. Sosialisasi Penggunaan Benih Bermutu Kelapa Sawit. Jurnal Pengabdian Kreativitas Pendidikan Mahakam (JPKPM) 1(2): 108–112.

Gülgün, O., dan Erol, H. 2019. Classification Performance Comparisons of Deep Learning Models in Pneumonia Diagnosis Using Chest X-Ray Images. *Turkish Journal of Engineering*, 4. doi:10.31127/tuje.652358.

Imaduddin, A.R., and Suharsono, T.N. 2023. Implementasi Metode *Convolution*al Neural Network Untuk Klasifikasi Citra Jamur Berbasis Mobile. Innovative: *Journal Of Social Science Research*, 3(5): 864–875. doi:10.31004/innovative.v3i5.4935.

Kurniawan, R., Martadinata, A.T., and Cahyo, S.D. 2023. Klasifikasi Tingkat Kematangan Buah Sawit Berbasis Deep Learning dengan Menggunakan Arsitektur Yolov5. *Journal of Information System Research (JOSH)*, 5(1): 302–309. doi:10.47065/josh.v5i1.4408.

Marpaung, R.E., Hardinata, J.T., and Nasution, R.A. 2022. Penerapan Algoritma K-Means Dalam Mengclustering Kualitas Bibit Kelapa Sawit Di PPKS Marihat. Zahra: Bulletin Big data, Data Science and Artificial Intelligence 1(1): 7–15.

Maulana, F.F., and Rochmawati, N. 2019. Klasifikasi Citra Buah Menggunakan *Convolution*al Neural Network. Journal of Informatics and Computer Science (JINACS), 1(02): 104–108. doi:10.26740/jinacs.v1n02.p104-108.

Mhasakar, P., Trivedi, P., Mandal, S., dan Mitra, S. 2021. Handwritten Digit Recognition Using Bayesian ResNet. *SN Computer Science*, 2: doi:10.1007/s42979-021-00791-6.

Nugroho, A. F., Susilo, E. H., & Purnomo, M. H. (2021). Penerapan Residual Networks (ResNet) untuk Klasifikasi Citra Penyakit Tanaman Padi. *Jurnal Teknologi dan Informatika Pertanian*, 13(2), 87-94. doi:10.25124/jtip.v13i2.2917

Prayoga, A., Maimunah, Sukmasetya, P., Muhammad Resa Arif Yudianto, dan Rofi Abul Hasani. Arsitektur *Convolution*al Neural Network untuk Model Klasifikasi Citra Batik Yogyakarta. Journal of Applied Computer Science and Technology 4(2): 82–89. doi:10.52158/jacost.v4i2.486.

Putra, R. D., Sari, P. R., & Yuliani, E. (2022). Implementasi YOLOv5 untuk Deteksi Objek pada Video Pengolahan Pertanian. Jurnal Teknologi Informasi dan Ilmu Komputer, 9(2), 141-150.

Rahmadani, I., Muqimuddin, M., Hertadi, C. D. P., & Nugroho, B. (2023). Klasifikasi Kualitas Hasil Produksi Tahu Putih menggunakan Metode

*Convolution*al Neural Network. Desember, 27(2), 2023–2035. https://doi.org/10.46984/sebatik.v27i2.2401

Redmon, J., Divvala, S., Girshick, R., & Farhadi, A. (2016). You Only Look Once: Unified, Real-Time Object *Detection*. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 779-788. doi:10.1109/CVPR.2016.91

Satia, G.A.W., Firmansyah, E., and Umami, A. 2022. Perancangan sistem identifikasi penyakit pada daun kelapa sawit (Elaeis guineensis Jacq.) dengan algoritma deep learning *convolution*al neural networks. Jurnal Ilmiah Pertanian 19(1): 1–10. doi:10.31849/jip.v19i1.9556.

Sevia, Yanti, D., Yanti, S. D., Rahma, H., Aziezah, N., Siskandar, R., Setiawan, A., Rekayasa, T., & Lunak, P. (2023). Analisis Pengaruh Artificial Intelligence Berbasis Images Preprocessing dalam Implementasi Deteksi Kematangan Buah Tomat. Jurnal Penelitian Teknologi Informasi Dan Sains, 1(4), 39–48. https://doi.org/10.54066/jptis.v1i4.1238

Sujatmiko, B.M., Yudaningtyas, E., and Raharjo, P.M. 2022. *Convolution* Neural Network Dengan Desain Jaringan Resnet Sebagai Metode Klasifikasi Tumor Kulit. Jurnal Simantec 11(1): 53–64.

Sukarna, R. H., Holilah, H., Damyati, F., & Hilman, M. (2024). Analisis Prediksi Kelulusan Mahasiswa Universitas Sultan Ageng Tirtayasa Menggunakan Algoritma Machine Learning dan Feature Selection. *Jurnal Ilmiah Sains Dan Teknologi*, *8*(2), 232 - 241. https://doi.org/10.47080/saintek.v8i2.3468

Syarovy, M., Nugroho, A.P., and Sutiarso, L. 2023. Pemanfaatan Model Neural Network Dalam Generasi Baru Pertanian Presisi Di Perkebunan Kelapa Sawit. WARTA Pusat Penelitian Kelapa Sawit 28(1): 39–54. doi:10.22302/iopri.war.warta.v28i1.97.

Tumewu, S.F., Setiabudi, D.H., and Sugiarto, I. 2020. Klasifikasi Motif Batik menggunakan metode Deep *Convolution*al Neural Network dengan Data Augmentation. Jurnal Infra 8(2): 189–194.

Triyogi, R., Magdalena, R., and Hidayat, B. 1. Mendeteksi Kematangan Buah Kelapa Sawit Menggunakan *Convolution*al Neural Network Deep Learning. 1 1(1): 22–27. doi:10.25124/jnst.v1i1.6732.

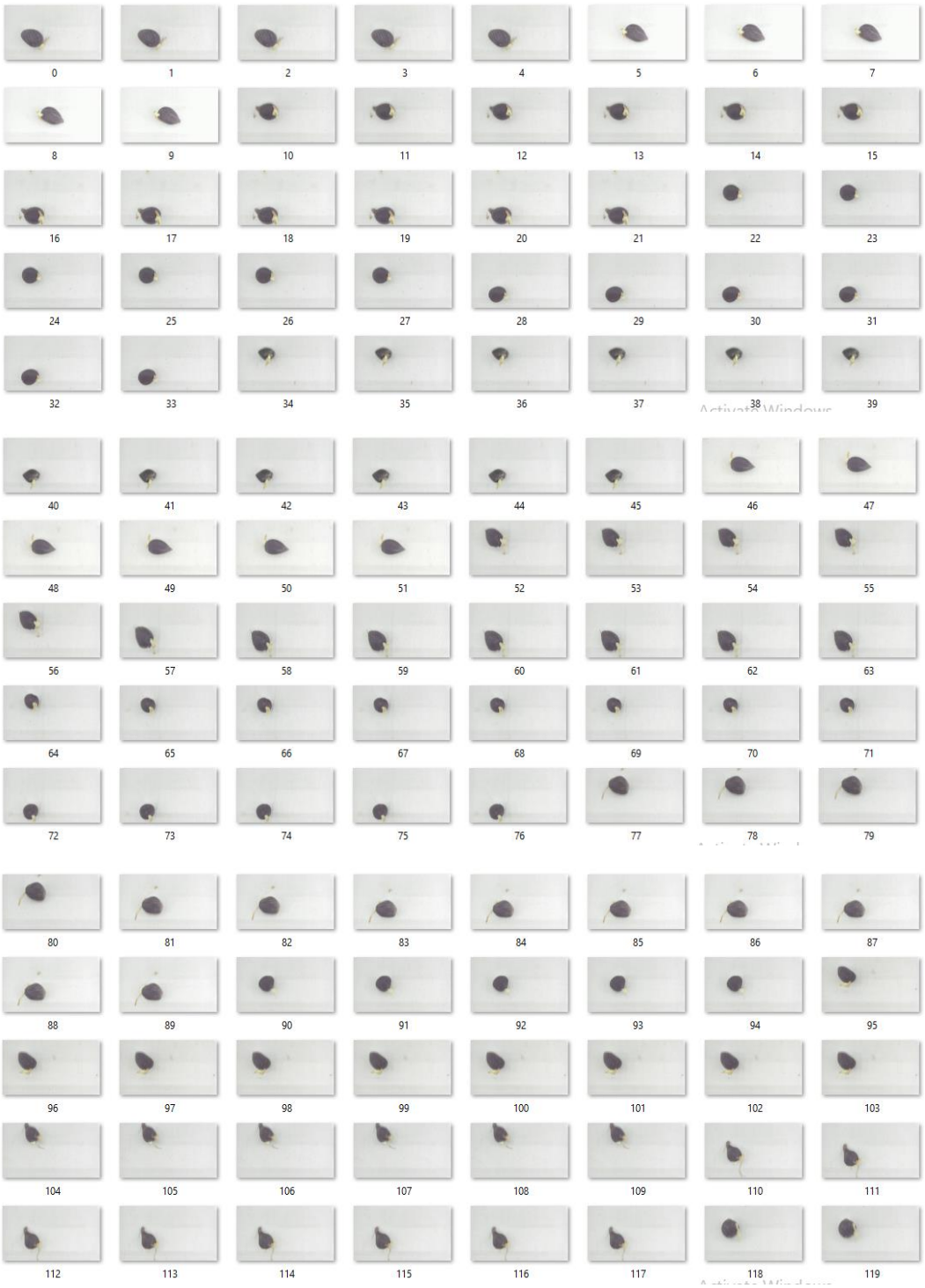
Yanti, S.D., Rahma, H., Aziezah, N., Siskandar, R., and Setiawan, A. 2023. Analisis Pengaruh Artificial Intelligence Berbasis Images Preprocessing dalam Implementasi Deteksi Kematangan Buah Tomat. Jurnal Penelitian Teknologi Informasi dan Sains 1(4): 39–48. doi:10.54066/jptis.v1i4.1238.

Zhou, Q., Li, X., Liu, L., Wang, J., Zhang, L., dan Liu, B. 2023. Classification of Seafloor Sediment in Northern Slope of South China Sea Based on Improved U-Net and K-Means Clustering Analysis. *Preprints*, doi:10.20944/preprints202305.2240.v1.

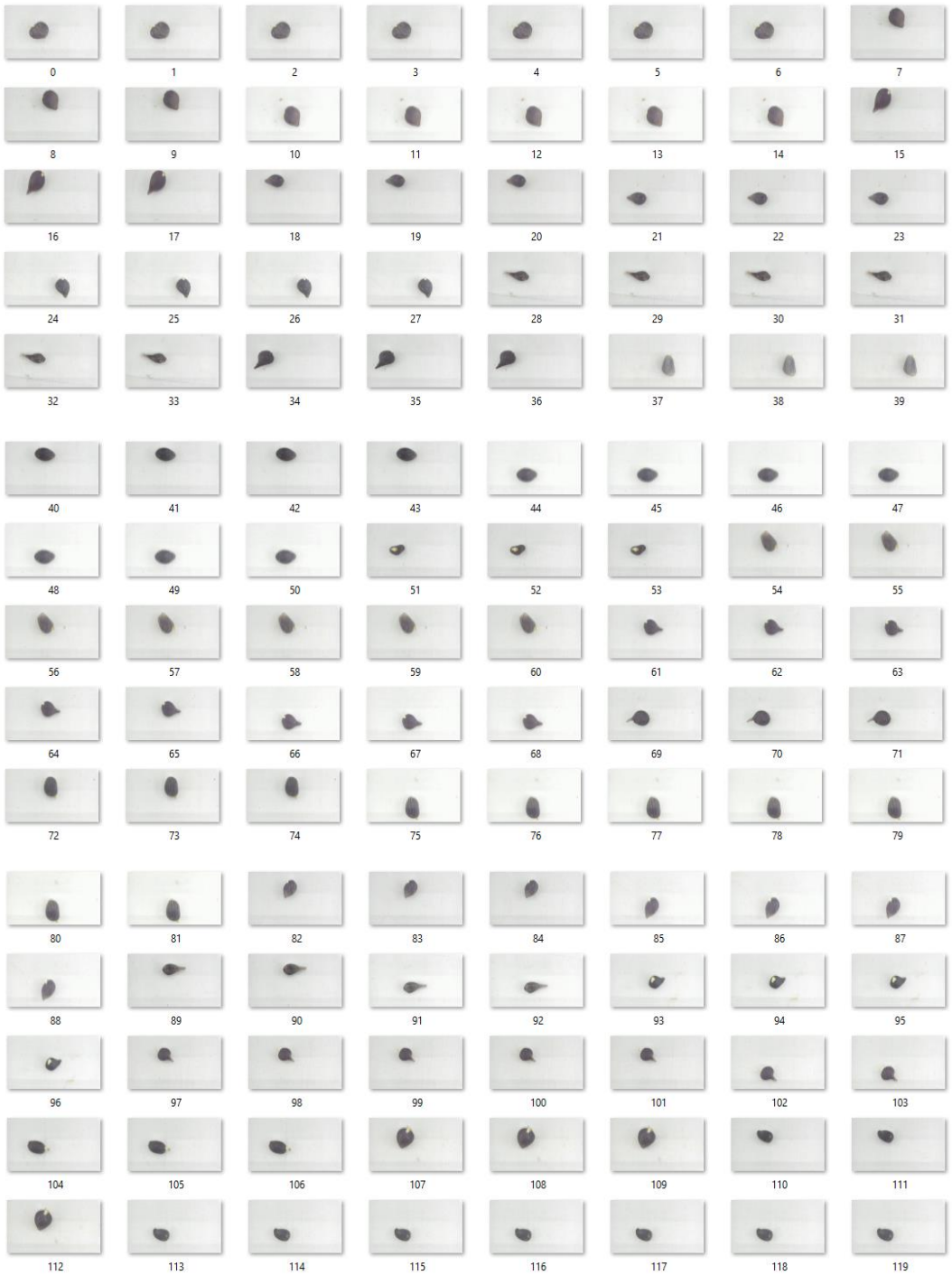
Zou, J., Han, Y., & Li, S. (2019). Deep learning-based feature selection for improved diagnosis of critical illnesses. *IEEE Access*, *7*, 68757-68768.

LAMPIRAN

Lampiran 1 Contoh Data Normal



Lampiran 2 Contoh Data Abnormal



Lampiran 3 Contoh *source code testing*

```
import os
import cv2
import torch
import torch.nn as nn
import numpy as np
from torchvision import models, transforms
from PIL import Image, ImageDraw, UnidentifiedImageError
from pathlib import Path
import shutil
```

```
# Definisikan YOLOObjectDetector yang telah dilatih
class YOLOObjectDetector:
    def __init__(self, model_path):
        self.model = torch.hub.load('ultralytics/yolov5', 'custom', path=model_path)
        self.model.eval()

    def detect_objects(self, image):
        results = self.model(image)
        return results.xyxy[0]  # Mengembalikan bounding box
```

```
# Fungsi untuk mengekstrak frame dari video
def extract_frames(video_path, output_dir):
    os.makedirs(output_dir, exist_ok=True)
    cap = cv2.VideoCapture(video_path)
    frame_count = int(cap.get(cv2.CAP_PROP_FRAME_COUNT))
    fps = int(cap.get(cv2.CAP_PROP_FPS))
    frames = []

    for i in range(frame_count):
        ret, frame = cap.read()
        if not ret:
            break
        frame_path = os.path.join(output_dir, f"frame_{i:04d}.jpg")
        cv2.imwrite(frame_path, frame)
        frames.append(frame_path)

        # Verifikasi penyimpanan frame
        try:
            img = Image.open(frame_path)
            img.verify()
        except (UnidentifiedImageError, OSError):
            print(f"Skipping frame {i} due to invalid image file.")
            os.remove(frame_path)
            frames.pop()

    cap.release()
    return frames, fps
```

```
# Fungsi untuk menggabungkan frame menjadi video
def create_video(frames, output_video_path, fps):
    frame = cv2.imread(frames[0])
    height, width, _ = frame.shape

    fourcc = cv2.VideoWriter_fourcc(*'mp4v')
    video_writer = cv2.VideoWriter(output_video_path, fourcc, fps, (width, height))

    for frame_path in frames:
        frame = cv2.imread(frame_path)
        video_writer.write(frame)

    video_writer.release()
```

```
# Fungsi untuk mendeteksi dan mengklasifikasikan objek di setiap frame
def process_frames(frames, detector, classifier, device, transform, output_dir):
    os.makedirs(output_dir, exist_ok=True)
    classified_frames = []

    for frame_path in frames:
        try:
            image = Image.open(frame_path).convert("RGB")
        except UnidentifiedImageError:
            print(f"Skipping file {frame_path} due to error.")
            continue
        boxes = detector.detect_objects(image)
        draw = ImageDraw.Draw(image)

        for box in boxes:
            box = box.cpu().numpy()
            cropped_image = image.crop((box[0], box[1], box[2], box[3]))
            cropped_image_tensor = transform(cropped_image).unsqueeze(0).to(device)
            output = classifier(cropped_image_tensor)
            _, pred = torch.max(output, 1)
            label = "Abnormal" if pred.item() == 0 else "Normal"
            color = (255, 0, 0) if label == "Abnormal" else (0, 255, 0)

            draw.rectangle([(box[0], box[1]), (box[2], box[3])], outline=color, width=3)
            draw.text((box[0], box[1] - 10), label, fill=color)

        output_frame_path = os.path.join(output_dir, os.path.basename(frame_path))
        image.save(output_frame_path)
        classified_frames.append(output_frame_path)

    return classified_frames
```

```
# Path video input dan output
video_path = "/kaggle/input/testing-40rpm10cm/Testing 40 RPM 10 CM.mp4"  # Ganti dengan path video input di Kaggle
frames_output_dir = "/kaggle/working/frames"
classified_frames_output_dir = "/kaggle/working/classified_frames"
output_video_path = "/kaggle/working/output_video.mp4"
```

```
# Model YOLO yang telah dilatih
yolo_model_path = '/kaggle/input/testing-40-rpm-10-cm-baru/yolov5/runs/train/exp/weights/best.pt'  # Ganti dengan path model YOLO di Kaggle
detector = YOLOObjectDetector(model_path=yolo_model_path)
```

```
# Model klasifikasi (ResNet18 yang telah dilatih)
classifier_model_path = "/kaggle/input/model-resnetnew/40 RPM 10CM/40 RPM, 10CM/model_bs16_lr0.0001_do0.3_ep35.pt"  # Ganti dengan path model klasifikasi di Kaggle
classifier = models.resnet18(pretrained=False)
num_ftrs = classifier.fc.in_features
classifier.fc = nn.Linear(num_ftrs, 2)  # 2 classes: Normal, Abnormal
classifier.load_state_dict(torch.load(classifier_model_path, map_location=torch.device('cuda' if torch.cuda.is_available() else 'cpu')))
classifier = classifier.to(torch.device("cuda" if torch.cuda.is_available() else "cpu"))
classifier.eval()
```

```
# Transformasi untuk preprocessing
transform = transforms.Compose([
    transforms.Resize((64, 64)),
    transforms.RandomHorizontalFlip(),
    transforms.RandomRotation(30),
    transforms.ToTensor(),
    transforms.Normalize((0.5,), (0.5,))
])
```

```
# Ekstrak frame dari video
frames, fps = extract_frames(video_path, frames_output_dir)

# Proses frame untuk deteksi dan klasifikasi objek
classified_frames = process_frames(frames, detector, classifier, torch.device("cuda" if torch.cuda.is_available() else "cpu"), transform, classified_frames_output_dir)

# Gabungkan frame yang telah diklasifikasi menjadi video
create_video(classified_frames, output_video_path, fps)

# Copy the output video to the Kaggle output directory for downloading
shutil.copy(output_video_path, '/kaggle/working/Testing_40RPM_10CM.mp4')
```

Lampiran 4 Lembar perbaikan skripsi

LEMBAR PERBAIKAN SKRIPSI

"IMPLEMENTASI VISI KOMPUTER UNTUK KLASIFIKASI KUALITAS BENIH KECAMBAH KELAPA SAWIT MENGGUNAKAN *CONVOLUTIONAL NEURAL NETWORK* (CNN)"

OLEH:

MUHAMMAD ILHAM NUR FURQAN
D121201072

Skripsi ini telah dipertahankan pada Ujian Akhir Sarjana tanggal 10 Oktober 2024.

Telah dilakukan perbaikan penulisan dan isi skripsi berdasarkan usulan dari penguji dan pembimbing skripsi.

Persetujuan perbaikan oleh tim penguji:

	Nama	Tanda Tangan
Ketua	Prof. Dr. Ir. Indrabayu, S.T., M.T., M.Bus.Sys., IPM,ASEAN. Eng.	
Anggota	Ir. Christoforus Yohannes, M.T	
	Elly Warni, S.T., M.T.	

Persetujuan Perbaikan oleh pembimbing:

Pembimbing	Nama	Tanda Tangan
I	Prof. Dr. Ir. Indrabayu, S.T., M.T., M.Bus.Sys., IPM,ASEAN. Eng.