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DARI SINI PENCERAHAN BERSEMI

Sistem Keputusan Otomatis Berbasis Fuzzy untuk Kelayakan Reuse Air Drain Mesin Retort

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Pendahuluan

Retort merupakan Perangkat sterilisasi makanan yang bekerja dalam suhu 121°C dan maksimal pressure 2 bar

Proses Retort Membutuhkan air dalam jumlah besar

- Air drain masih berpotensi digunakan Kembali
- Penilaian manual tidak konsisten dan rawan human error
- Diperlukan system keputusan otomatis

Penelitian Terdahulu

- **Penerapan fuzzy logic untuk monitoring kualitas air**

  Dalam studi fuzzy Mamdani / Sugeno pada air minum, air limbah, RO, PLTU
- **Sistem monitoring berbasis IoT**

  fokus pemantauan pH, suhu, atau kualitas air secara real-time

Research Gap :

- Penelitian sebelumnya hanya monitoring atau rekomendasi
- Belum ada sistem pengambilan keputusan otomatis
- Belum diterapkan khusus pada air drain mesin retort industri pangan
- Belum terintegrasi dengan kontrol valve otomatis

Rumusan Masalah

- Bagaimana merancang prototipe sistem monitoring multi-parameter untuk menilai kelayakan reuse air proses mesin retort secara real-time?
- Bagaimana mengimplementasikan metode fuzzy logic untuk pengambilan keputusan kelayakan air retort berdasarkan multiple input parameters?
- Bagaimana mengintegrasikan hasil keputusan fuzzy dengan sistem kontrol otomatis untuk routing aliran air secara real-time?

Tujuan Penelitian

- Merancang dan menguji prototipe monitoring multi-parameter (turbidity, pH, TDS) untuk menilai kelayakan reuse air retort.
- Menerapkan fuzzy logic Mamdani berbasis standar food-grade untuk menghasilkan keputusan kelayakan reuse.
- Mengintegrasikan keputusan fuzzy dengan kontrol valve otomatis untuk routing air ke reuse, treatment, atau WWTP.

Manfaat Penelitian

Ekonomi dan Lingkungan

sistem ini dapat mengurangi biaya pengadaan air dan pengolahan limbah serta menerapkan praktik industri ramah lingkungan sesuai prinsip circular economy jika di implementasikan dalam industri.

Operasional

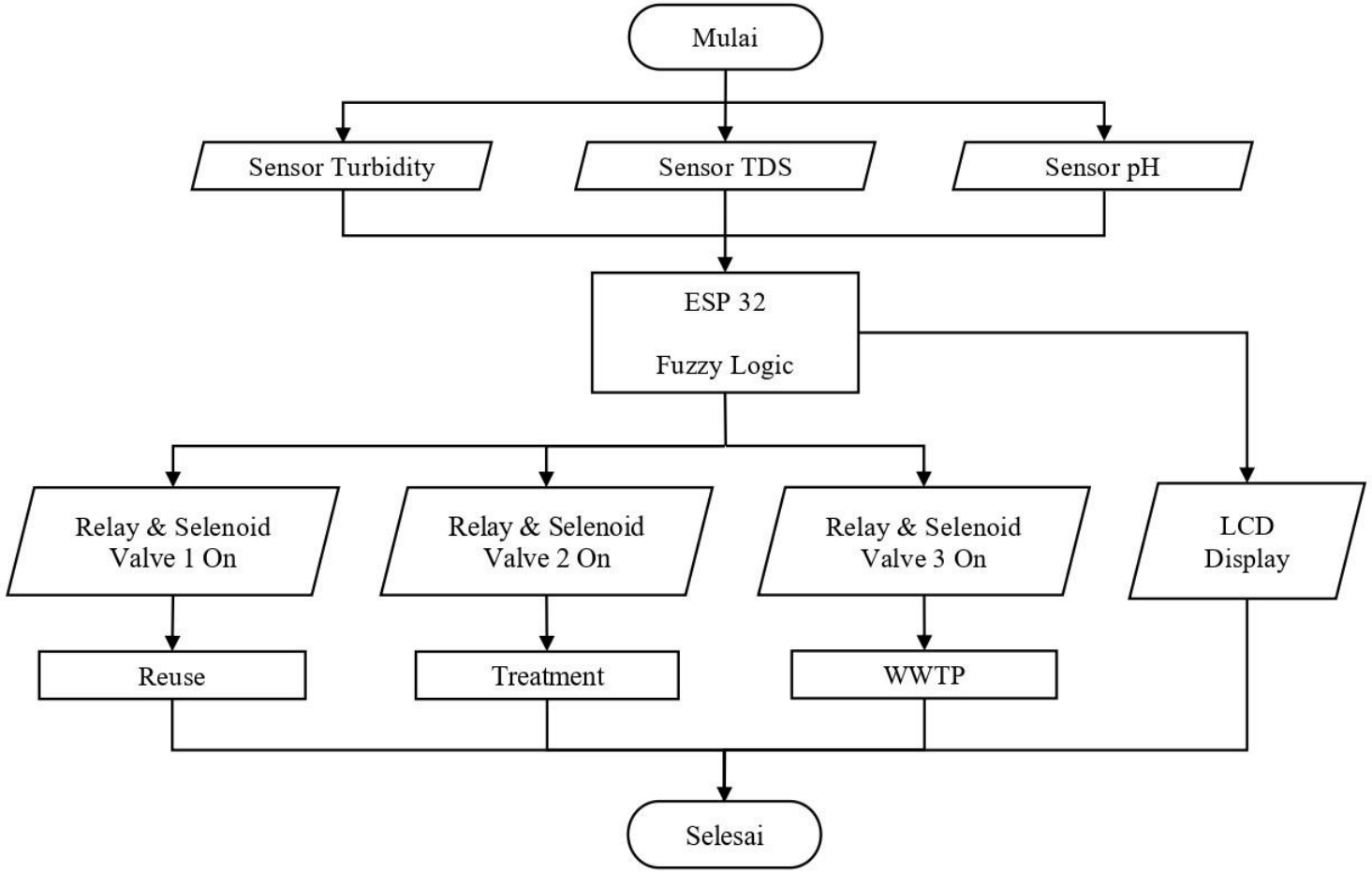
Eliminasi human error dan inkonsistensi dengan keputusan objektif berbasis standar food-grade jika di implementasikan dalam industri.

Metode

Metode Research and Development (R&D) dengan Perancangan Prototype Sistem

Data turbidity, pH, dan TDS diolah menggunakan fuzzy logic Mamdani untuk menentukan kelayakan reuse air pada 30 sampel uji.

Blok Diagram Sistem



Fuzzy Logic

Tahapan Proses

Fuzzifikasi
Konversi nilai sensor ke derajat keanggotaan fuzzy

Evaluasi Rule Base
Basis aturan fuzzy (27 Rules)

Inferensi (min-max)
Agregasi output menggunakan operator maksimum

Defuzzifikasi (Centroid)
Konversi fuzzy ke nilai crisp (z*)

Input

Turbidity (0-300)	pH (0-14)	TDS (0-2000)
1. Low	1. Asam	1. Low
2. Medium	2. Netral	2. Medium
3. High	3. Basa	3. High

Output

REUSE (100 > 60)	**Treatment (70 > 30)**	**Reject (40 > 0)**

Fuzzy Logic

Basis Aturan Fuzzy

No	Turbidity	TDS	pH	Output
1	High	Low	Asam	Reject
2	High	Low	Netral	Reject
3	High	Low	Basa	Reject
4	High	Medium	Asam	Reject
5	High	Medium	Netral	Reject
6	High	Medium	Basa	Reject
7	High	High	Asam	Reject
8	High	High	Netral	Reject
9	High	High	Basa	Reject
10	Medium	Low	Asam	Treatment
11	Medium	Low	Netral	Reuse
12	Medium	Low	Basa	Treatment
13	Medium	Medium	Asam	Treatment
14	Medium	Medium	Netral	Treatment
15	Medium	Medium	Basa	Treatment
16	Medium	High	Asam	Treatment
17	Medium	High	Netral	Treatment
18	Medium	High	Basa	Treatment
19	Low	Low	Asam	Treatment
20	Low	Low	Netral	Reuse
21	Low	Low	Basa	Treatment
22	Low	Medium	Asam	Treatment
23	Low	Medium	Netral	Treatment
24	Low	Medium	Basa	Treatment
25	Low	High	Asam	Treatment
26	Low	High	Netral	Treatment
27	Low	High	Basa	Treatment

Pembahasan

Hasil Pengujian Sensor dan Logika Fuzzy:

- Akurasi sensor: < 1%
- Akurasi keputusan fuzzy: 100%

✓ Seluruh skenario pengujian sesuai dengan perhitungan manual.

✓ Rule override turbidity berfungsi dengan baik

✓ Defuzzifikasi metode centroid menghasilkan nilai crisp yang tepat

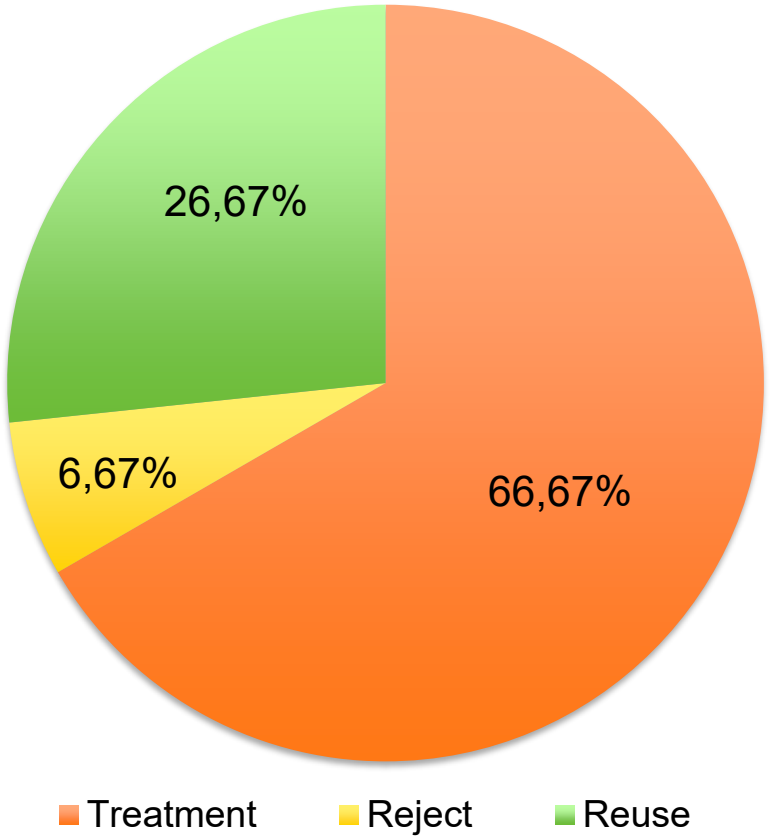
Pembahasan

Total volume uji: 18.000 ml

Hasil klasifikasi:

- Reuse: 26,67%
- Treatment: 66,67%
- Reject: 6,67%

Potensi reuse: 93,33% (±16.800 ml)



Kesimpulan

- Implementasi fuzzy logic Mamdani dengan 27 rule base menghasilkan akurasi keputusan 100% sesuai perhitungan manual
- Integrasi keputusan fuzzy dengan kontrol valve otomatis berhasil mengarahkan aliran air tanpa kesalahan aktivasi
- Sistem bekerja otomatis dan real-time
- Berpotensi meningkatkan efisiensi industri

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