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Penerapan Keypoint Detection Untuk Digitalisasi Data Analog Gauge Berbasis Model Yolo Pose Pada Fasilitas PT. Parama Data Unit
Tri Rambu Nugroho Prasetyo, Dr.Eng. Ir. Ganjar Alfian, S.T., M.Eng.
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INTISARI

PENERAPAN *KEYPOINT DETECTION* UNTUK DIGITALISASI DATA *ANALOG GAUGE* BERBASIS MODEL YOLO POSE PADA FASILITAS PT. PARAMA DATA UNIT

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Industri hulu minyak dan gas menghadapi tantangan *monitoring* instrumen *analog gauge* yang masih dilakukan secara manual, sehingga rentan terhadap *human error*, tidak efisien, dan berisiko bagi keselamatan personel. Proyek akhir ini bertujuan mengembangkan model *keypoint detection* berbasis *deep learning* dan mengintegrasikannya ke dalam sistem pembacaan *analog gauge* berbasis *website.* Metode yang digunakan adalah *You Only Look Once* (YOLO) 11 Pose melalui eksperimen variasi arsitektur (YOLO11n/s-Pose), jenis dataset pelatihan (dengan dan tanpa *preprocessing crop*), augmentasi Albumentations, serta perbandingan metode inferensi *one-stage* dan *two-stage*. Konfigurasi terbaik diperoleh pada YOLO11s-Pose dengan dataset *preprocessing crop* dan augmentasi Albumentations, menghasilkan *Object Keypoint Similarity* (OKS) 0,8100, *Mean Absolute Error* (MAE) 28,30 px, *Root Mean Square Error* (RMSE) 38,50 px, *Mean Absolute Percentage Error* (MAPE) 3,98%, dan *Latency* 19,9 ms. Metode inferensi *two-stage* terbukti lebih unggul dibandingkan *one-stage* dengan OKS 0,7836, MAE 31,42 px, RMSE 42,97 px, MAPE 4,27%, dan peningkatan *Latency* 8,79 ms. Sistem website yang dibangun memenuhi seluruh pengujian fungsional dengan nilai *User Acceptance Testing* (UAT) sebesar 89,17% dari PT Parama Data Unit.

Kata kunci: *Analog Gauge, Keypoint Detection,* YOLO Pose*,* Digitalisasi*, Computer Vision*

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ABSTRACT

APPLICATION OF KEYPOINT DETECTION FOR THE DIGITIZATION OF ANALOG GAUGE DATA USING THE YOLO POSE MODEL AT THE PT. PARAMA DATA UNIT FACILITY

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The upstream oil and gas industry faces challenges in monitoring analog gauge instruments that are still performed manually, making the process prone to human error, inefficient, and hazardous to personnel safety. This final project aims to develop an optimal deep learning-based keypoint detection model and integrate it into a web-based analog gauge reading system. The method employed is You Only Look Once (YOLO) 11 Pose through experimental variations of architecture (YOLO11n/s-Pose), training dataset type (with and without crop preprocessing), Albumentations augmentation, and a comparison of one-stage and two-stage inference methods. The best configuration was achieved by YOLO11s-Pose with crop preprocessing dataset and Albumentations augmentation, yielding Object Keypoint Similarity (OKS) of 0.8100, Mean Absolute Error (MAE) of 28.30 px, Root Mean Square Error (RMSE) of 38.50 px, Mean Absolute Percentage Error (MAPE) of 3.98%, and Latency of 19.9 ms. The two-stage inference method proved superior to the one-stage method with OKS of 0.7836, MAE of 31.42 px, RMSE of 42.97 px, MAPE of 4.27%, and an increased Latency of 8.79 ms. The developed website system passed all functional tests and achieved a User Acceptance Testing (UAT) score of 89.17% from PT Parama Data Unit.

Keywords: *Analog Gauge, Keypoint Detection, YOLO Pose, Digitalization, Computer Vision*