# 📝 NLP Project – Technical Lead Report (Week 3-4)

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**Start Date**: 18 August

**End Date**: 31 August

## ✅ 1. Work Completed (Since Last Report)

\_What you’ve built, implemented, tested or reviewed and an estimate as to how many hours it took to complete

* ROS2 implementation improvements (~3 hr)
* Standard topics publishers and subscribers (~0.5 hr)
* RTAB-Map and SLAM research (~4 hr)
* Project scope evaluation and architectural discussions (~1 hr)
* **Feature/Module:** ROS2 Implementation Improvements
  + Enhanced ROS2 container communication architecture for better stability
  + Improved data flow between Flask application and ROS2 nodes
  + Optimized message passing and reduced communication latency
  + Strengthened error handling and recovery mechanisms in ROS2 integration
* **Feature/Module:** Standard Topics Publishers and Subscribers
  + Implemented standardized ROS2 topic structure for video/audio data streams
  + Created reliable publisher nodes for video feed and audio capture
  + Established subscriber nodes for command processing and status updates
  + Ensured consistent message formats across all communication channels
* **Feature/Module:** RTAB-Map and SLAM Research
  + Conducted comprehensive research into RTAB-Map SLAM implementation
  + Analyzed integration requirements and computational overhead
  + Evaluated feasibility of real-time SLAM within current system constraints
  + Assessed benefits and limitations of SLAM for drone localization
* **Feature/Module:** Project Scope Evaluation
  + Discussed potential reduction in project scope regarding ROS2 elimination
  + Analyzed implications of removing SLAM functionality from system requirements
  + Evaluated trade-offs between system complexity and functional requirements
  + Assessed impact on drone localization accuracy without SLAM
* **Tools/Libs Used:**
  + ROS2 framework for improved node communication
  + RTAB-Map documentation and examples for SLAM research
  + Standard ROS2 message types for video/audio streaming
  + Docker containers for ROS2 environment management
* **Outcome/Results:**
  + Successfully improved ROS2 communication stability and performance
  + Established robust publisher/subscriber architecture using standard topics
  + Gained comprehensive understanding of RTAB-Map SLAM implementation requirements
  + Identified critical issues with drone localization if SLAM is eliminated
* **Contributions (if applicable):**
  + Implemented standardized topic structure for better maintainability
  + Conducted thorough research into SLAM integration possibilities
  + Led architectural discussions regarding project scope and complexity trade-offs
* **Tools/Libs Used:**
  + Flask framework for web application architecture
  + Threading libraries for concurrent processing pipelines
  + OpenCV for video processing and Structure From Motion
  + YOLOv11 (ultralytics) for enhanced object detection performance
  + WebSocket for real-time web interface communication
  + Global state variables for inter-thread data sharing
* Outcome/Results:
  + Successfully refactored system into modular, maintainable Flask architecture
  + Achieved real-time object detection with 100ms processing intervals while maintaining smooth video playback
  + Implemented working depth detection using Structure From Motion techniques
  + Created comprehensive web-based control interface for system monitoring and control
  + Established robust threading architecture supporting concurrent video, audio, and AI processing
* Contributions (if applicable):
  + Designed and implemented complete system architecture refactor
  + Built Flask-based web control interface with real-time capabilities
  + Optimized object detection pipeline for improved performance
  + Integrated depth detection with object tracking accumulation
  + Created comprehensive system documentation and flowchart
  + Established threading architecture for concurrent processing

## 📌 2. Current Tasks in Progress

\_What you’re actively working on. Include blockers if any.\_

|  |  |  |  |
| --- | --- | --- | --- |
| Task | Description | ETA | Blockers |
| YOLOv11 fine-tuning | Optimizing YOLOv11 model parameters for drone-specific detection scenarios | ~4 hours | Model compatibility testing |
| Depth accuracy validation | Testing Structure From Motion accuracy across different scenarios | ~6 hours | Need diverse test environments, camera stabilization for smooth motion |
| Threading optimization | Fine-tuning concurrent processing efficiency and synchronization | ~4 hours | Thread synchronization complexity |
| Project scope finalization | Determining final architecture with or without ROS2/SLAM components | 2 hours | Team consensus on scope reduction |

## 📅 3. Upcoming Tasks

\_Planned work for the next sprint or phase.\_

* **Task:** Voice Pipeline Completion
* **Purpose/Goal:**
  + Complete voice activation detection and command processing pipeline
  + Implement microphone live stream with "ok drone" activation phrase detection
  + Integrate speech-to-text (Whisper) and intent processing (Ollama LLM) nodes
  + Establish command status flow ("none" → "new" → "processing" → "complete")
* **Dependencies:**
  + Audio capture system setup
  + STT and intent processing node integration
  + Project scope finalization
* **Task:** Drone Localization Solution (if SLAM eliminated)
  + **Purpose/Goal:**
    - Develop alternative localization method without SLAM
    - Implement error correction for accumulated position drift
    - Establish reliable home position tracking system
    - Minimize localization errors during multiple movement sequences
  + **Dependencies:**
    - Final decision on SLAM elimination
    - Alternative positioning algorithm research
* **Task:** WebUI Live Video Integration
  + **Purpose/Goal:**
    - Integrate live video feed display into web control interface
    - Add AI overlay rendering to web-based video stream
    - Implement real-time video streaming via WebSocket to browser
  + **Dependencies:**
    - Stable video processing pipeline
    - WebSocket video streaming implementation
* **Task:** System Architecture Finalization
  + **Purpose/Goal:**
    - Finalize system architecture based on scope decisions
    - Update documentation to reflect architectural changes
    - Ensure all components align with final scope requirements
  + **Dependencies:**
    - Project scope finalization
    - Team agreement on final requirements

## 🚨 4. Issues & Risks

\_Bugs, technical debt, resourcing, or anything threatening progress.\_

|  |  |  |  |
| --- | --- | --- | --- |
| Issue | Impact | Suggested Action | Owner |
| Video processing latency | Delays between live video and AI processing overlays affect real-time performance | Optimize frame buffering and reduce processing overhead | Ed |
| Inconsistent FPS performance | Variable frame rates affect smooth video playback and user experience | Implement adaptive frame rate control and resource management | Team |
| Video quality degradation | Processing pipeline reduces video quality affecting detection accuracy | Optimize compression and maintain higher quality throughout pipeline | Team |
| Inaccurate depth detection | Structure From Motion calculations significantly off from actual distances | Recalibrate depth algorithms and improve feature matching accuracy | Ed |
| Drone localization without SLAM | Eliminating SLAM creates significant challenges for accurate drone positioning relative to home | Research alternative localization methods or maintain minimal SLAM implementation | Team |
| Error propagation in positioning | Multiple drone movements without SLAM lead to accumulated positioning errors | Implement error correction algorithms and position validation systems | Team |

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## 📈 5. Key Insights / Recommendations

\_Lessons learned, suggestions, architecture notes, or optimizations.\_

* ROS2 standardization significantly improves system reliability and maintainability through consistent topic structures
* RTAB-Map SLAM integration would provide substantial localization benefits but increases system complexity considerably
* Eliminating ROS2 may reduce complexity but sacrifices standardization and potential future scalability
* Drone localization without SLAM presents significant challenges, particularly for maintaining accurate home position after multiple movements
* Error propagation in positioning becomes critical issue without SLAM - alternative correction mechanisms essential
* Project scope reduction discussions highlight need for clear priority definition between system simplicity and functional capability