INTERNSHIP PROJECT UPDATES

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ABOUT ME?

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Med-Surgical

Projects & Innovation

Localized Tracking of Hugo RAS Robotic Arms

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What?

A localized arm tracking system that can give location updates to server & avoid mis-happenings

Additional recall feature (reset arm locations to initial)

A study into the safety of surgical robots has linked the machines' use to at least 144 deaths and more than 1,000 injuries over a 14-year period in the US.

The events included broken instruments falling into patients' bodies, electrical sparks causing tissue burns and system errors making surgery take longer than planned.

Dynamic collision avoidance for multiple robotic manipulators based on a non-cooperative multi-agent game

Nigora Gafur, Gajanan Kanagalingam and Martin Ruskowski

***Abstract*—A flexible operation of multiple robotic manipulators in a shared workspace requires an online trajectory planning with static and dynamic collision avoidance. In this work, we propose a real-time capable motion control algorithm, based on non-linear model predictive control, which accounts for static and dynamic collision avoidance. The proposed algorithm is formulated as a non-cooperative game, where each robot is considered as an agent. Each agent optimizes its own motion and accounts for the predicted movement of surrounding agents. We propose a novel approach for collision avoidance between multiple robotic manipulators. Additionally, we account for deadlocks that might occur in a setup of multiple robotic manipulators. We validate our algorithm on multiple pick and place scenarios and different numbers of robots operating in a common workspace in the simulation environment Gazebo. The robots are controlled using the Robot Operating System (ROS). We demonstrate, that our approach is real-time capable and, due to the distributed nature of the approach, easily scales up to four robotic manipulators with six degrees of freedom operating in a shared workspace.**

***Index Terms*—Robotic manipulators, collision avoidance, non-cooperative multi-agent game, distributed model predictive control, motion control, deadlock, ROS.**

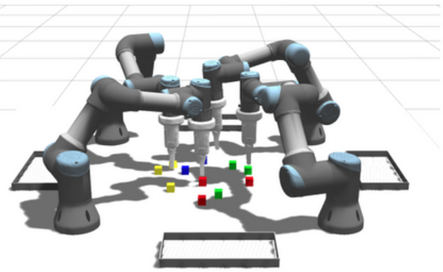

Fig. 1: Setup for a pick and place scenario with four collaborative UR3 manipulators.

of all involved manipulators is necessary. For that reason, it is

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Can hamper progress of surgery & damage to patient & environment

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Initial location/orientation

Instantaneous location mapping

Raising alerts based on location maps

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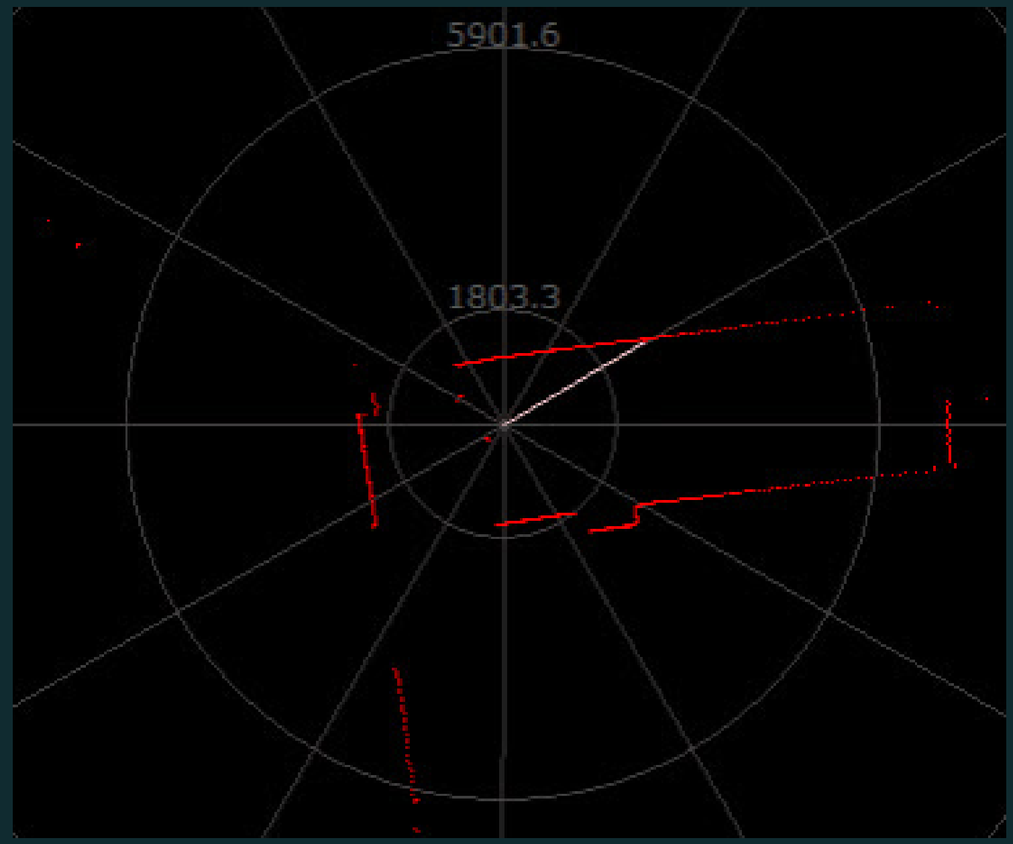
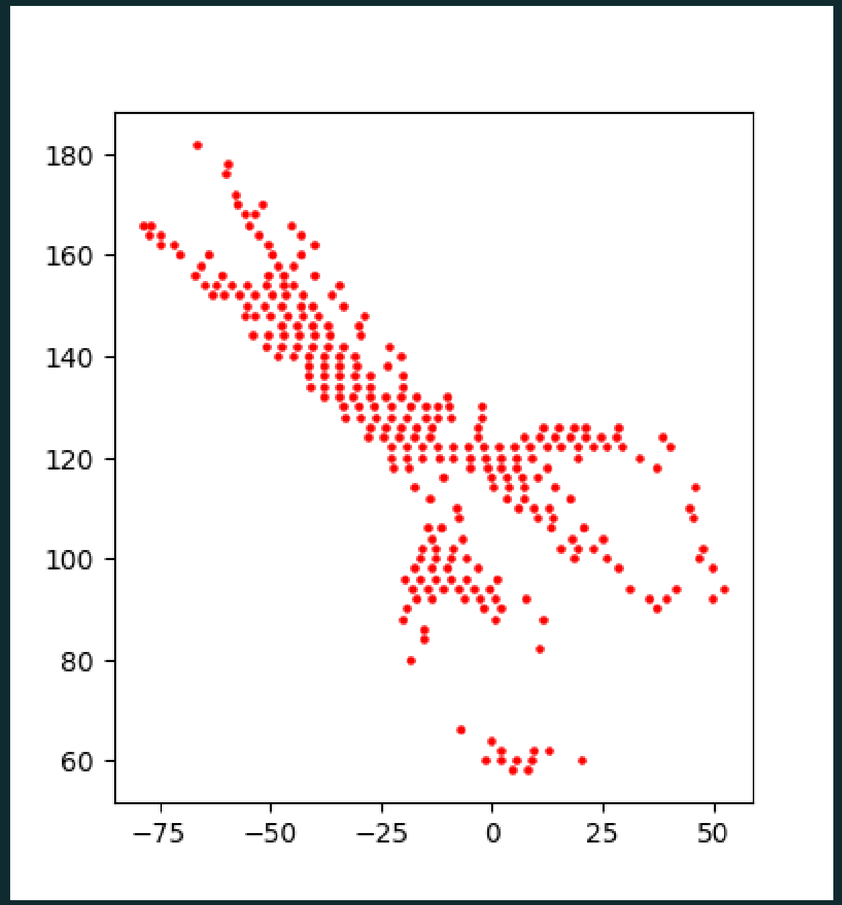
Technology under consideration: LiDAR, UWB, Chirp (CSS), Ultrasound
Indoor positioning techniques : Two Way Ranging (TWR), TDoA, AoA, RSSI

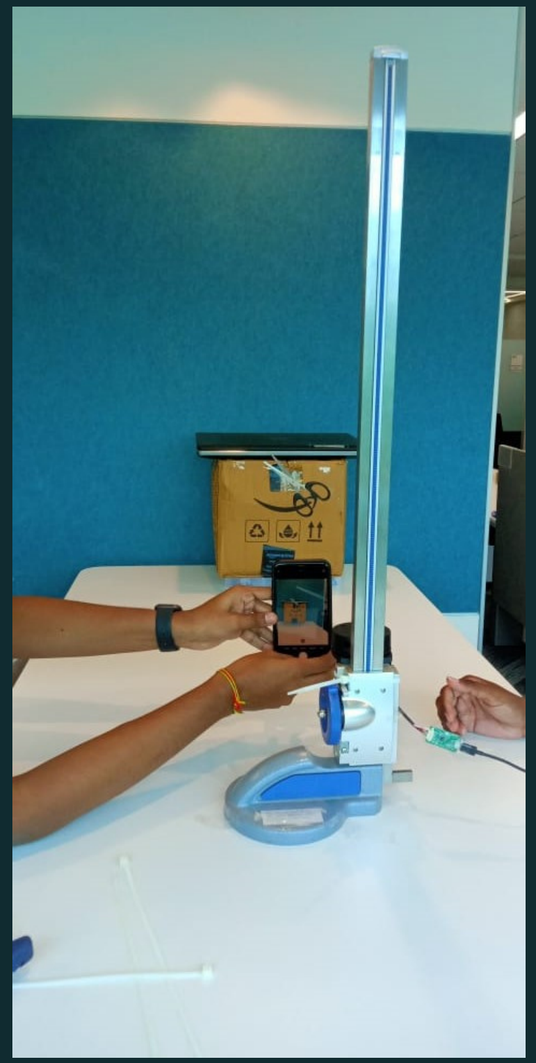
Object segmentation & classification of LiDAR point cloud data

2D LiDAR



Object segmentation & classification of LiDAR point cloud data





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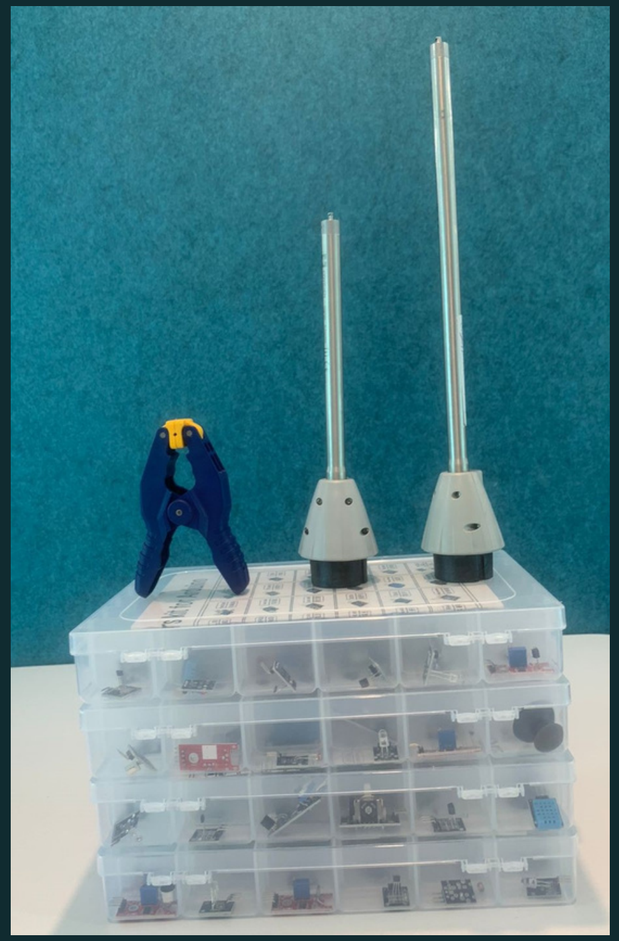

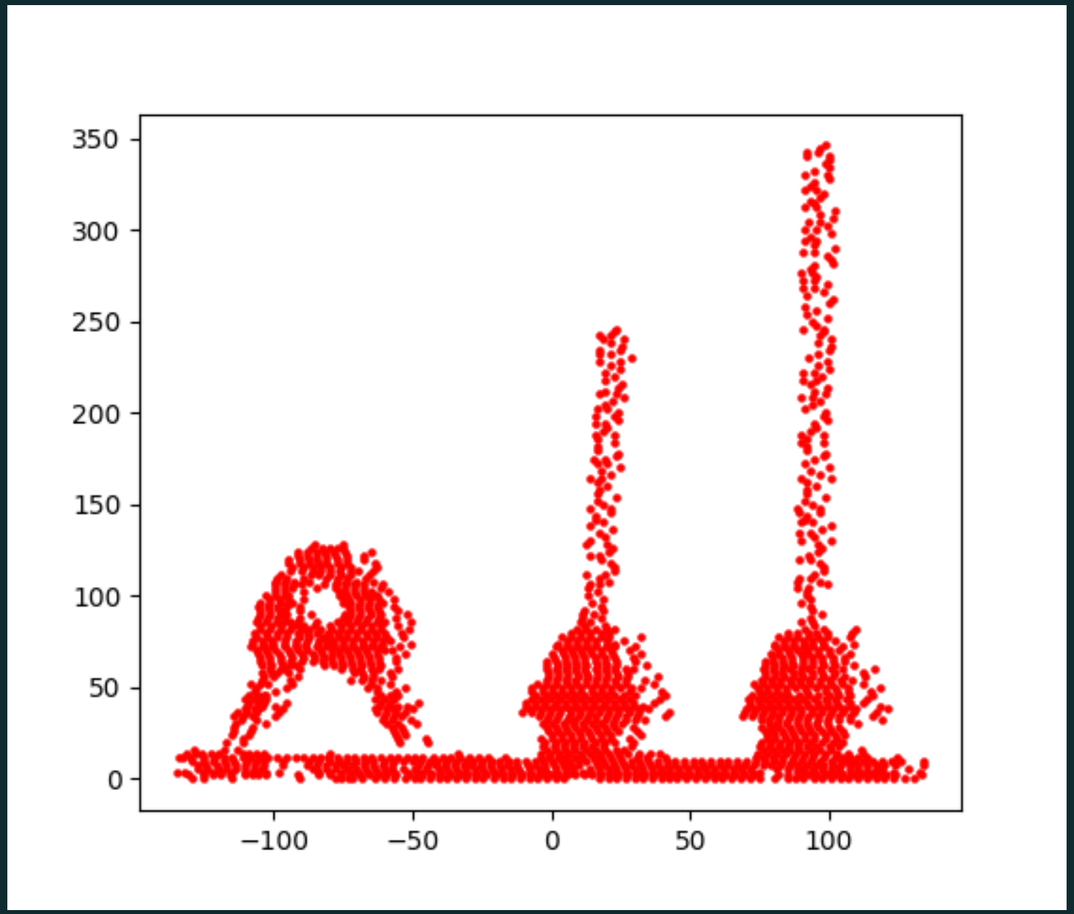

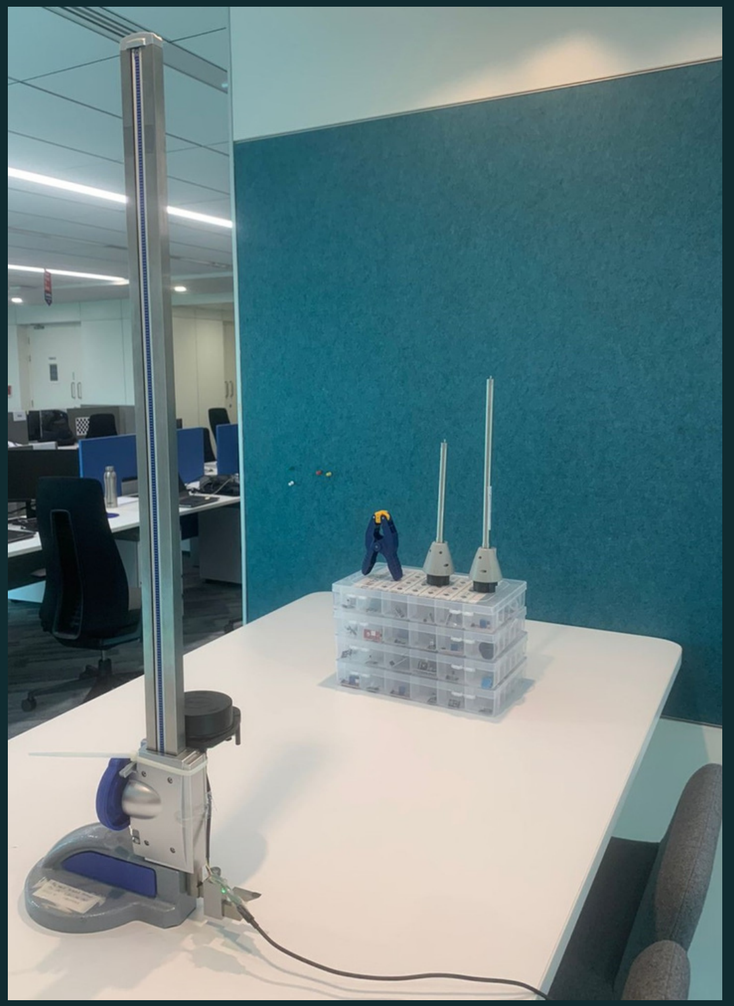

Exploration of iRobot Roomba

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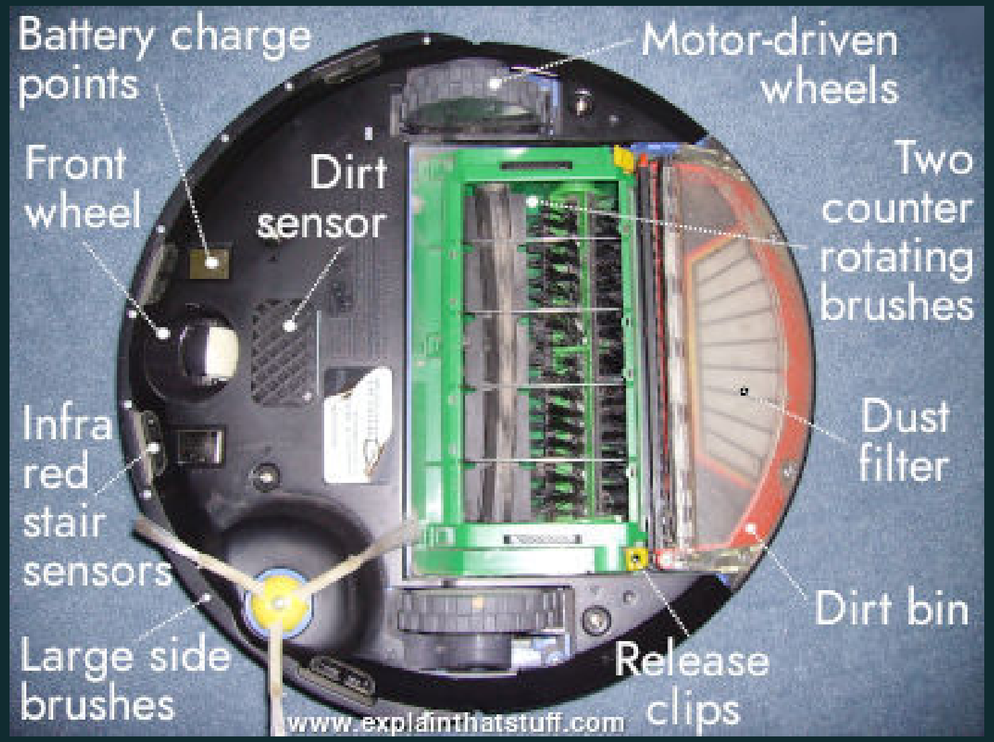


IR Sensor - to sense objects in vicinity/stairs in downward direction

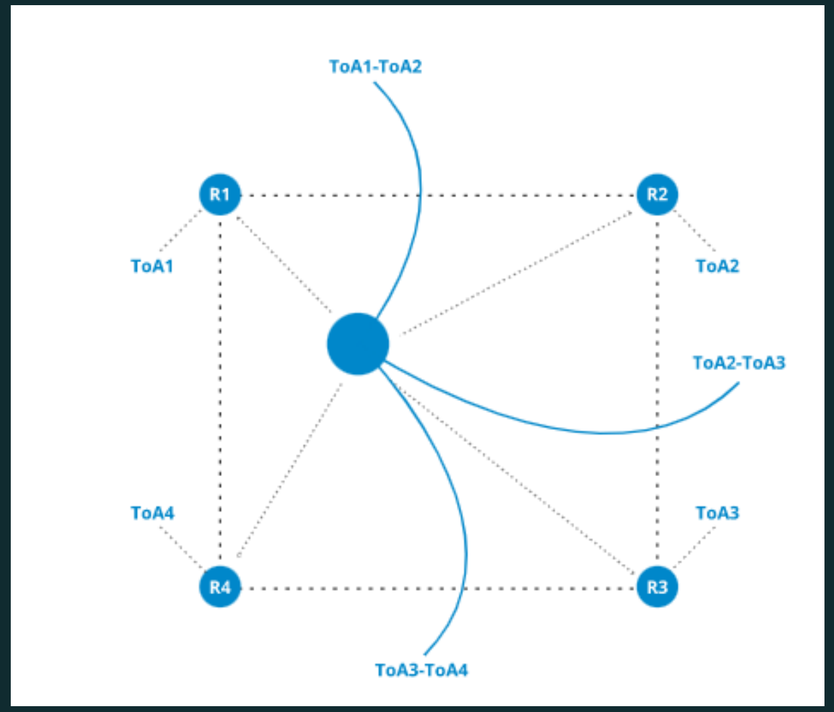
Piezolelectric sensor - to generate electric impulses on dirt striking

House mapping - VSLAM using infrared cameras (at 45 deg); remembers and tracks features of objects (odometry for localization)

Other Exploration

Calibration (for initial system configuration)

- Parametric speakers + Ultrasound detectors
- UWB / Chirp based localization
- RTLS Techniques



Problem Statement 2

Color-based filtering for Laproscopic video processing

Color-based segmenting for Laproscopic video processing

What?

Globally, 300 million+ surgeries per annum

Surgery recordings have to be processed before releasing publicly to eliminate potentially confidential information to protect patient and healthcare provider

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Why?

Provide automated premise for detailed processing (DS1)

Greater frame processing: Data transfer rates become slower and computationally expensive

Color-based segmenting for Laproscopic video processing

What?

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Why?

Provide automated premise for detailed processing (DS1)

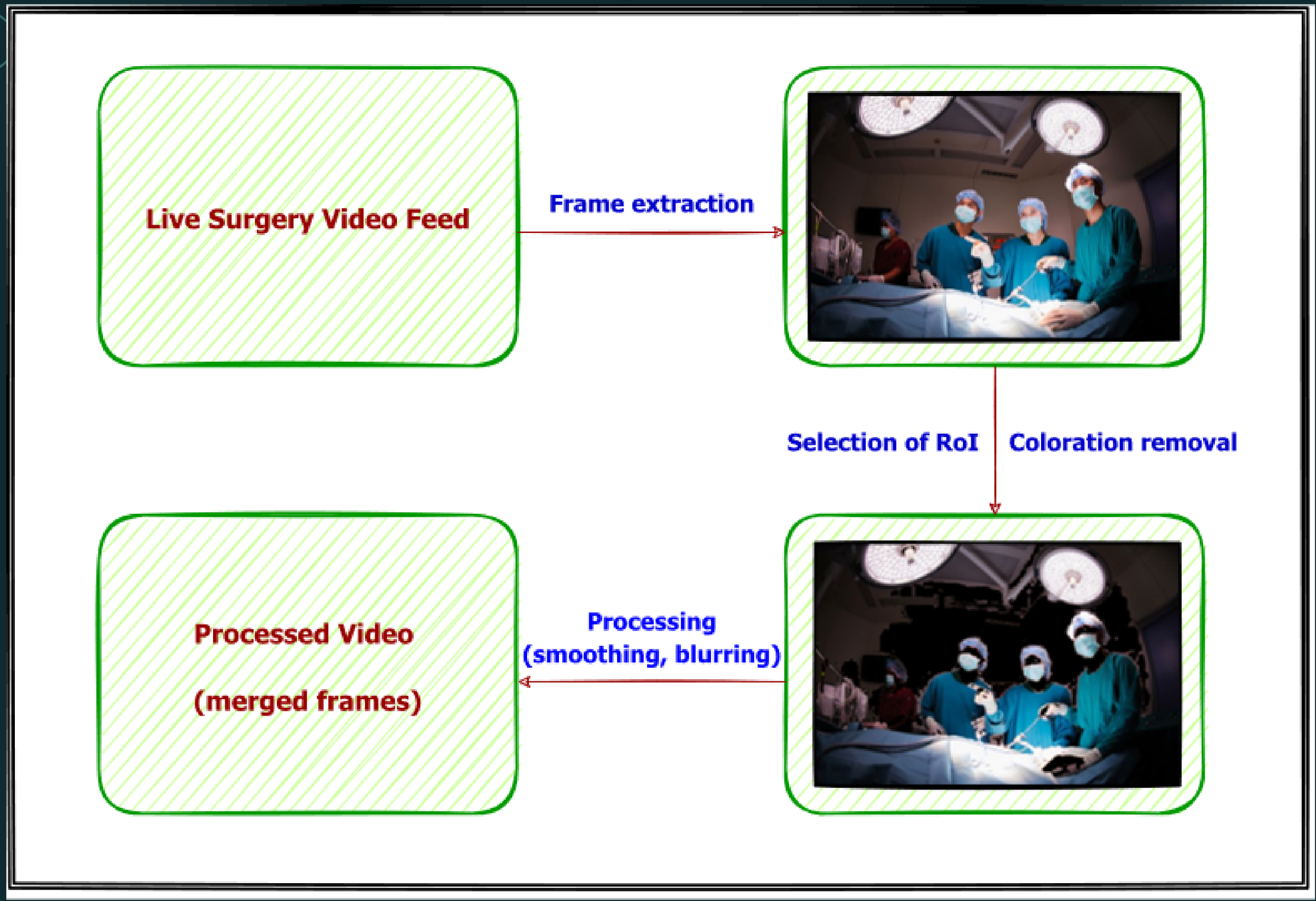
Greater frame processing: Data transfer rates become slower and computationally expensive

How?

Allow coloration (user defined) to be retained/removed in live video feed

Choice of Region of Interest (RoI) prevents elimination of useful sections

Color-filtering based Laproscopic video processing



THANK YOU!