**Updated Risk Register**

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| Project Title: | Robotics for the inspection of confined space | | | Date: | 19/04/2025 |
| Group Members: | Madeleine Kane | Alen Joseph | Muhammad Bin Suratman | Muhammad Md  Nazri | George Bowen |
| Supervisors: | Simon Watson | | Paul Wright | | |

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| **Risk Type** | **Risk Description** | **Potential**  **(Low, Medium, High)** | **Severity**  **(Low, Medium, High)** | **Mitigation Measures** |
| Technical Risks | Failure to redesign Inchworm and continuum actuation systems effectively | Medium | High | Perform detailed simulations using CAD and kinematic analysis tools (e.g., MATLAB, SolidWorks). Test prototypes iteratively in real-world mock-up environments. Seek regular feedback from stakeholders and supervisors. |
| Challenges in adapting the continuum unit for turning in the gantry | Medium | High | Perform environmental tests replicating the gantry’s 90-degree corners. Implement adaptive algorithms to optimize movement in constrained conditions. Develop alternate systems simultaneously to allow for unexpected issues in one and still have a working solution. |
| Software data loss or corruption during development | Low | High | Use version control systems like GitHub for regular backups, enabling code recovery in case of accidental loss or corruption. |
| Failure to fully integrate the mechatronics system with sensors and control systems | Medium | High | Break integration into manageable phases. Conduct unit testing for each subsystem, followed by hardware-in-the-loop (HIL) testing.  Use simulations to develop sensing and control systems simultaneously to mechatronic and work on development of non-final mechatronic prototypes early on in project. |
| Actuators/motors fail to provide the forces as expected | Medium | High | Perform detailed torque and force testing during the design phase. Incorporate gearing systems or upgrade to higher-spec actuators to amplify force output. Consider methods to lower forces in all aspects, considering all possible potential energies that the system must counter and how to lessen the forces due to these. |
|  | Sensor inaccuracies in the gantry testing | Medium | High | Implement sensor fusion algorithms to combine data from all sensors. Perform calibration tests in mock-up gantry. Thoroughly test all sensors prior to implementation into sensing system and then post sensor fusion as well. |
|  | Unintended damage to gantry surfaces during robot operation | Low | High | Use non-invasive materials (e.g., rubber-coated contact points). Conduct impact tests and include protective measures like soft bumpers to minimize damage risks. |
| Commercial Risks | Failure to meet Amentum and National Highways’ specific needs | High | Low | Maintain regular engagement with stakeholders to align objectives and system functionality. Conduct validation tests in collaboration with Amentum to ensure expectations are met. |
| Budget overruns leading to inability to complete the project or deliver key functionalities | Medium | High | Conduct detailed cost planning with contingency for unforeseen expenses. Regularly update the budget tracker and prioritize critical components over supplementary features. |
| Managerial Risks | Ineffective project management leading to delays | Medium | Medium | Use project management software (Gantt charts) and other methods (Kanban) to track progress. Assign clear responsibilities and deadlines for each task. Continually review goals and objectives for each week and check the previous weeks achievements. |
| Team communication issues leading to misaligned objectives | Medium | Medium | Hold regular team meetings and establish clear communication channels on WhatsApp channel. When not having regular meetings (non-teaching periods) team manager will ensure everyone checks in on progress once a week. |
| Resource shortages (materials, testing facilities) | Medium | Medium | Secure access to critical resources early in the project.  Establish backup options for materials. Consider alternate designs that avoid the use of difficult to source resources to have insurance plans. |
| Teammate experienced a serious injury | Low | High | Assign a buddy system to ensure workload coverage. Maintain documentation for team roles to facilitate redistribution of tasks during unforeseen absences. |
| Procurement risk Includes order and manufacturing delays, and logistical disruptions. | Medium | High | Plan orders and manufacturing early, and ensure timely delivery and cost stability. Where necessary develop alternate solutions if lead times are uncertain. |
| Unexpected errors in design mean incomplete system | High | Medium | Ensure documentation of all stages of the process, allowing for proof of concept even if not a fully integrated prototype. Turning mechanisim identified as highest risk factor for this so develop multiple solutions to mitigate impacts of manufacturing delays and lead times. |