**Quarterly Report**

**[Project Name]**

**[Principal Investigator Last Name]**

* **Executive Summary**

[Please, provide a brief one paragraph overview of your project activities so far, i.e. the technology you are developing, societal or economic problem it might solve, what you accomplished and what key challenges a still ahead.]

We are developing an autonomous robot on an omnidirectional platform for the tomato greenhouse monitoring. Timely detecting an insect invasion or an infection in modern greenhouse is crucial, and this is exactly what we are aiming at. Prior to the grant we have created a prototype and tested its locomotion in the real environment. Now we are mostly concerned with the technical side of the project, i.e. computer vision and the mechanical platform itself.

* **Project development**

[Please, in sufficient level of details describe what research work was done in the project. Clarify the current status of the innovation and any related intellectual property. Emphasize what results you believe to indicate project future success and what key challenges did you encounter. What was your approach to manage known issues and potential risks?]

During the first quarter we were primarily focused on the Computer Vision-related part of the project. In particular, we have coordinated the data markup, which resulted in a dataset consisting of nearly 5k marked images. We have analysed the markup in terms of the consistency. We have trained several neural networks in order to have options for different speed and precision requirements.

Also we have tested several cameras with global shutter, including the ones with wide-angle optics. We have evaluated their performance in terms of the quality of the images that they produce. As a result, we have identified the models that we are going to use in the next version of the prototype.

Apart from the Vision, we have found a substitution for a motor that was damaged during the testing phase. We are working on the integration of this motor into the control system of the robot.

The robot that is being developed has a unique feature of being capable of both omnidirectional motion and traversing two types of support: rails and concrete floor. We have not attempted to patent that yet, although it may make sense to do so in the future. Another thing that could deserve patenting is the dataset that we have collected.

The main indicators of the project future success are the following. First, we have successfully tested the robot in the real environment. Second, we have already finished operations for the first contract with the industrial customer. Third, we have gathered the (already mentioned) data, obtained its markup, and trained a Neural Network with the quality well above the minimal acceptable.

* **Milestones**

[Please, fill in the following table]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Milestone planned for the report period | Initially outcomes expected | | Actual outcomes | Comments, proposals, potential solutions for unresolved issues |
| Powdery milder dataset |  | Marked data | Marked data |  |
| Trained NN |  | 0.8 accuracy | 0.85 accuracy |  |
| Data transport on ROS2 |  | Data transport on ROS2 | Data transport on ROS2 |  |

* **Commercialization**

[Please, write a story answering the following questions. What did you do to start commercialization of your project? Describe what you learn about market situation. How did you get this knowledge and which sources did you use?]

We have been working with the first customer, which is a big agricultural company with special interest in tomato farming. We have signed a contract for the data collection and NN training, that was finished successfully. The plan is to continue to work with the same company with bigger contracts, in particular along the lines of modifying the robot and selling it to the customer.

From the words of the managers in charge of this agricultural company, taking into account the current political situation, buying and leasing european equipment is difficult and not reliable enough. There are some schemes in the shades of gray, including importing certain technologies through Kazakhstan, but they could be cut off at any point.

Thus, the company is generally interested in the development of a domestic alternative to the foreign agricultural robots and in the development of novel robots, that are not even present in the market.

One of the team members gave a talk on an agricultural conference, presenting our work to the potential customers from the Krasnodarsky region in Russia. A number of them were interested in the autonomous platform. Now we are working on the establishment of the contact with them.

* **Intellectual property**

[Please, explain if you submitted technology disclosure to KTO or were involved in other IP related activities? Describe other object of IP, such as IP of competitors, which you have studied during the reporting period.]

We have not participated in any of the legal IP-related operations yet.

Among the patents on the topic of autonomous greenhouse monitoring we were not able to find any that describe the mechanical scheme that was used in the developed platform. It could mean that (after more exhaustive search) the proposed scheme has a patent potential.

* **Budget and resources**

[Please, fill-in the table below and explain how you managed resources?]

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Type expenditure of | | Approved budget | Actual figures | Comments |
|  |  |  |  |  |

* **Team and collaborations**

List team members and clearly explain their personal contributions. Explain if you used partner support and what they exactly did for the project?]

Ilya Osokin was responsible for the system integration, general shaping of the technical solutions. He has worked with all the other team members, assuring that the parts and subsystems merge properly. Also he has handled the paperwork, conference presentations, business meetings, and media coverage of the project.

Sina Moghimi has worked on the electrical subsystem of the robot, including low-level programming of the microcontrollers, welding and fixing driver boards. Along with that he has been busy gathering a ROS2 package for the robot.

Ilya Ryakin was involved in the data markup and NN training. He has conducted experiments with several modern architectures, trained them and evaluated their performance. He has researched the market of the Global Shutter cameras, ordered and tested them in the outdoor environment.

Sergei Davidenko has voluntarely participated in the camera pole model development. He has proposed several designs, carried out their static load simulation and modal analysis. Also he was involved in brainstorming the choice of the motor.

Mikhail Patrikeev has voluntarely (after his involvment under PSA was complete) participated in the brainstorming the choise of the motor and the development of the camera pole. He has given useful recommendations regarding the troubleshooting in the robot.

Pavel Osinenko was handling the business and administraive sides of the project. He was involved in the paperwork, presentations, and meetings with the customer. Generally, Pavel’s major role is in project supervision and quality management of the overall work.

* **Plans for next period**

[Please, explain key tasks for next project period what, when and how do you plan to achieve? What should and planned to be done differently as compared with described period?]

The main tasks to be solved during the next quarter are the following.

First, we have to reconsider the design of the suspension system. It turned out that the robot should be smaller in width, and also the motors have to be come immune to backdriveability in terms of the draining of the extra energy. For now we are planning to use motors that are integrated

Second, the vision subsystem has to be finalized. The neural network itself, data transport, logging have to be integrated into a coherent network with ROS2 framework.

Third, in contrast to the first quarter we have to pay extra attention to the application for Skolkovo residence. It will require lots of paperwork, but still, the plan is to finish the appliccation in Q3.