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MOBILE ROBOTIC PLATFORM WITH THE COLLECTION UNIT FOR SOIL SAMPLES

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Abstract: *This project is dedicated to the development of a robotic mobile platform with the integrated collection unit for soil samples, which must meet the criteria: speed of at least 5 km / h, the turning radius not more than 1 m, carrying capacity not less than 50 kg, the availability of automatic and remote control mode, and low cost. The system consists of a mobile platform, which contains in its structure master controller, a set of sensors, and a module for collecting soil samples, representing a 3-coordinate pneumatic positioner. Tests for optimization of the sliding the process of the pilot prototype of the platform development. Elements of this development can be used to creating robots for extreme operating conditions. For example, the Mars rovers.*
Key words: *robot, a mobile platform, pneumatic positioner*

1. INTRODUCTION

Technological accidents and catastrophes, the probability of which is high enough, are almost inevitable because of increasing complexity of production with the use of energy-efficiency technologies, radioactive and toxic substances. It is impossible to conduct routine repairs and replacement of worn equipment, reduces the requirements for effectiveness of the supervisory authorities and the State Inspectorate, the fall of technological and production discipline, reducing the skill level of staff leads to irreversible consequences. In this situation, a particular danger are objects of chemical and nuclear industries. Worn-out equipment running is a constant threat to health service staff, and any emergency situation the operation may lead to an accident or disaster. Affecting factors, the resulting form extreme conditions for survival are not only saved but also the personnel of rescue workers, cope with the consequences of accidents.

One of the unsolved problems in the factories, facilities with hazardous working conditions is to reduce the degree of human factor during the working process in the hazardous conditions. This problem can be solved by using remotely controlled equipment. In this situation, an important consideration is the creation of robotic systems, designed for environmental monitoring, sample collection, execution of works to prevent or eliminate the consequences of emergency situations. . Elements of this development can be used to creating robots for extreme operating conditions. For example, the Mars rovers.

The work was carried out on the basis of the International Scientific-Educational Center BSTU-Fest "Synergy" Baltic State Technical University "VOENMECH" (St. Petersburg, Russia).

2. MOBILE PLATFORM

The developed platform is a six-wheeled cart, with four independent drives; body of this robot is made of impact-resistant and radiation-resistant materials that provide high reliability when working in hostile environments. Tank type

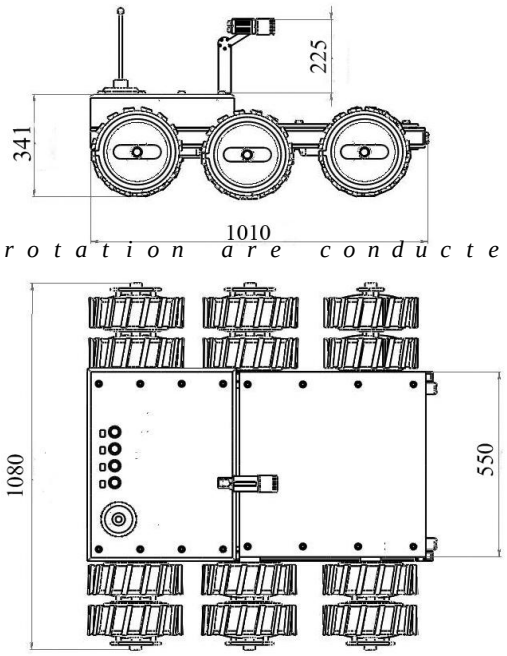

Fig. 1. The general view of the mobile platform

execution of the rotation allows to minimize the turning radius and increases structural rigidity. Overall dimensions of the developed platform are presented in Fig. 1.

The design of the robot includes a video camera, ultrasonic and optical sensors for the orientation in the surrounding area. Computation center of the robot are 2 controllers: master controller and command controller, which located in the special interference-protected block. The robot is equipped with internal power supply to 24V, which allows to work normally within 4 hours. It is important to note that the element base of the robot was specially selected to ensure the greatest protection to the chemically hazardous objects. There are 3 blocks in the robot with software: Master controller, programmed controller and a control unit of engines. Remote control is carried out by 4-channel transmitter (40MHz).

Platform characteristics:

- Speed - 8 km / h
- Turning radius -0.5 m
- Weight -31 kg
- Load capacity - 57 kg
- Height of the overcoming obstacles - 80 mm
- Control range with the usage of the radio channel -520 m
- Control range with the usage of the cable line - up to 75 m

One of the benefits is also a low center of mass, which does not allow the platform to roll. The upper tier of the platform can be used to install additional user equipment (manipulators, sensors, cargo container).

While applying such a scheme an experimental prototype has been designed and assembled, the exploitation of which has

revealed a few flaws: coefficient of friction is very high during the full reversal and at low discharge of batteries does not allow the robot to turn around, high efficiency loss when using a wheel hub with a clutch, on the rough country platform has big chance "to sit on its belly" because of the distances between the wheels.

After further development the independent drive axle between the drive wheels was added, which should be at 20 mm lower than driving wheels. With this solution, the mobile platform can easily swivel either on the front 2 leading wheels and 2 central wheels, or on the rear 2 leading wheels and 2 central wheels. As one of the pairs of driving wheels is almost donôt touch the ground - coefficient of friction for the entire platform is significantly reduced. Just add a third axis excludes the possibility of a mobile platform to sit on its belly, which greatly increases its terrain quality.

3. COLLECTION UNIT FOR SOIL SAMPLES

Collection unit for soil samples was designed for this platform. This unit is constructed from the pneumatic components of the company FESTO. Special vacuum attachment is supplied with the original grip for the fixation of the soil inside of it. With the help of the pneumatic coordinate manipulator, soil sample falls into the one of 40 containers for samples. Figure 2. shows a general view of the unit for collecting soil samples.

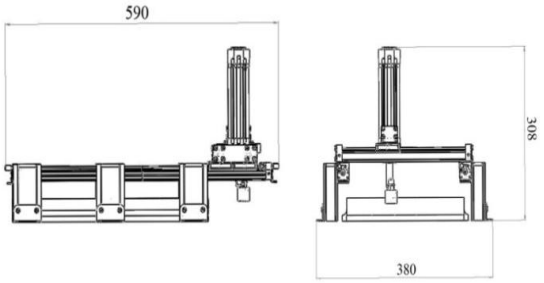

Fig. 2. The general view of the collection unit for soil samples

The control system was developed on the basis of the controller SPC200 is a versatile, modular-structured controller, which allows to have a relationship with pneumatic and electric axes and field tires. Depending on the equipment, the controller can be connected to four axes.

As a capture this module uses a standard vacuum generator with a specially designed nozzle to work with the soil. The nozzle is a cylinder connected thread on the one hand the vacuum nozzle. To avoid contact with samples of soil in a pneumatic nozzle mounted inside the filter.

4. DEMONSTRATION PROTOTYPE

Demonstration prototype was designed to test the selected solution. The prototype is a four-wheeled cart, with a four motor-reducers. The platform is made of steel profiles. As the drives have been used geared motors from car windows. This prototype uses tank type rotation, which allows to minimize the turning radius and increases structural rigidity.

The design of the robot includes WI-FI camera, ultrasound, and 2 optical sensors for orientation in the surrounding space. Robot control system based on the controller FEC Compact. The robot is equipped with internal power supply to 24V, which allows you to operate normally during 1,5 hours. Remote control is accomplished through 40MHz 4-channel transmitter. Assembled prototype demonstration proved the validity of decisions on the choice of wheel rotation schemes and systems.

Fig. 3. Four-wheeled cart with a four motor-reducers

5. THE RESULTS

At this stage of development achieved the following results:
Å A robotic mobile platform was designed. Expected price of the product should be substantially lower than market counterparts.
Å Collection unit for soil samples.
Å Demonstration prototype.
Å Commercialization of this project with a usage of business plan is in process.

6. AREAS OF POSSIBLE APPLICATION

Mobile platform is designed to (take into account the existence of different modules):
Å to work in hazardous areas (prospecting, sampling, excavation, removal and destruction of building structures and industrial equipment, transportation of dangerous goods);
Å Execution of works in emergencies (check the accident site, dismantling and destruction of damaged structures, manipulation of radioactive and highly toxic matter, fire fighting);
Å Take bomb works work (search, extraction, transportation and neutralization or destruction of explosive devices and unexploded ordnance, blasting).
Mobile Platform with integrated collection unit of soil samples intended for remote or automatic sampling of soil from the surface for further analysis on various factors. Can be used on the territories of the following objects:
Å Plants for the production of chemical products
Å Nuclear power plants (The complex is fully focused on work at the SELA, including a new block under construction)
Å Places of radioactive and chemical waste
ÅElements of this development can be used to creating robots for extreme operating conditions. For example, the Mars rovers.

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