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of Food Technologies*



International Competition of Student Scientific Works

BLACK SEA SCIENCE 2020

Information Technology, Automation and Robotics

Proceedings

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3. Erkan, B., Bozduman, T. A Research On Comparative Advantages In Germany's Technology-Intensive Exports. *Reter Lang* [https://www.researchgate.net/publication/328637829_A_RESEARCH_ON_COMPARATIVE_ADVANTAGES_IN_GERMANY'S_TECHNOLOGY-INTENSIVE_EXPORTS].
4. Fuchs, Ch., Industry 4.0: The Digital German Ideology. *TripleC* [https://www.researchgate.net/publication/323677944_Industry_40_The_Digital_German_Ideology].
5. Electronic resource: [https://www.weforum.org/reports/global-competitiveness-report-2019].
6. Electronic resource [https://www.trade.gov/knowledge-product/germany-information-and-communications-technology]
7. Electronic resource [https://www.statista.com/statistics/794070/germany-top-online-stores-germany-ecommercedb/]
8. Electronic resource [https://ec.europa.eu/digital-single-market/en/news/digital-europe-programme-summary-report-targeted-consultation-future-investment-europes-digital]
9. Electronic resource [https://cordis.europa.eu/projects].
10. Electronic resource [https://germanyworks.com/branch/ict/#downloads].
11. Electronic resource [https://www.de.digital/DIGITAL/Redaktion/EN/Publikation/digital-strategy-2025.pdf?__blob=publicationFile&v=9].
12. Electronic resource [https://uk.practicallaw.thomsonreuters.com/w-008-4095?transitionType=Default&contextData=(sc.Default)&firstPage=true&bhcp=1].
13. Electronic resource [https://group.atradius.com/publications/market-monitor-ict-germany-2019.html].
14. Electronic resource [https://ec.europa.eu/digital-single-market/en/european-legislation-reuse-public-sector-information].
15. Electronic resource [https://ec.europa.eu/eurostat/web/microdata/community-statistics-on-information-society].

ROBOTIC SEARCH SYSTEM FOR PEOPLE

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The robotic platform is designed to detect people in buildings during emergencies.

Introduction

In an era of man-made development, humanity is exposed to harmful or life-threatening factors. In the last decade, a number of man-made and natural hazards have come to terms with people, demanding new methods of detected casualties. It prompted us to prototype a work platform that would be able to reach a large, don't accessible or hazardous area, where there are victims and give for basic medical care. The basis is taken a 4x4 wheel platform (fig.1) .



fig.1

The use of this platform made it possible to prototype the robotic platform with high throughput. The platform has devices installed that will find a person, be able to measure his vitality (heart rate) and signal the location of a living object. Robotic platform, for better control, can be equipped with an IP camera, manipulator and first aid kit.

In his work it is planned to use a metal platform on crawler motors. This enhancement preserves all design features, reducing the blind platform clearance, you can install extra payloads, install equipment for finding people, breathing equipment, a radio device for communication between rescuers and victims.

It is planned to install a GPS tracker to guide the evacuation route or to advance the rescue crew. The passing properties are due to the paired operation of the left and right wheels. Maneuverability is explained by the work of wheels "on a caterpillar type".

Use of robots in rescue operations.

Robots have long been used to save people's lives. They are used in surgery as laboratory assistants, assistants, pharmacists [1]. From the second half of the twentieth century robots are used to eliminate accidents and dangers created by human activity [2]. Many concepts for robots have been developed to search for humans, including the robot snake [3]. Its advantages are as follows:

- mobility.
- high cross.
- pipe extension available.

Disadvantages:

- there is no importance between the victims and the rescuers.
- short battery life.
- no verified credentials.
- drug delivery available.
- it is impossible to transmit signals to the victims.

In recent years, robotic platforms have been developed to address the effects of fires. Also work is used for delivery of medicines, cargoes, ammunition, etc. They allow to get the fire-fighting equipment to the most accessible places. For search and rescue, human and animals are mostly used. The goal was to create a simple robotic platform that would allow you to reach inaccessible places. The following criteria were assigned to the design of the robot:

- Simple design. The reduced number of mechanical moving parts increases the reliability of the platform. And also a small number of components will reduce the load on energy resources, which will allow to extend the battery life of the device.

- A minimal set of sensors will allow you to remotely evaluate the situation around you, which will allow you to assess the chances of surviving victims and the possibility of their evacuation.

- Built-in human condition sensor. Namely, the built-in heart rate sensor will allow you to remotely evaluate the basic human vital mill.

- Possibility of remote control and autonomous operation in case of departure work beyond the perimeter of the remote control signal.
- High permeability in difficult conditions.
- Maneuverability.
- Lightweight construction designed to reduce pressure on the chassis of the robot and on the material of the surface (in the case of loose surfaces) to reduce the possibility of slipping and burial.
- Ability to alert when a live object is detected.
- Ability to install remote video equipment.

The design of the search engine and the main aspects of design

The robotic platform was based on the Arduino Mega platform based on the ATmega2560 chip. Wheel base in the prototype of the platform used standard acrylic two-deck platform 4x4 (fig. 1). In the future, it is planned to replace the aluminum platform with a caterpillar type. The L298d collector motor driver is used to control the motors (Fig. 2).

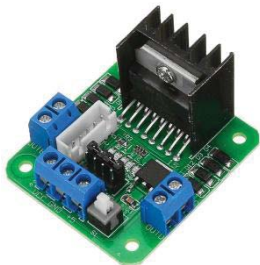


Fig.2

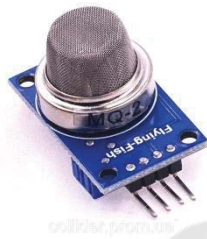


Fig.3



Fig.4

Engines are started in parallel on each side. This inclusion method offers significant benefits:

- Engines run on a crawler type.
- The friction between the wheels and the road surface increases.
- Increases maneuverability and reduces arc radius when turning. Possibility to return in place.
- even distribution of traction on the undercarriage of the chassis.
- Uniform load on all wheels of the platform.

A built-in power stabilizer located on the driver plate provides power up to 20 volts. The driver also allows you to control the speed of the left and right wheels. This will allow the platform to maneuver smoothly. To study the state of the air on the subject of toxic substances in the robot provided the use of a gas sensor (fig. 3).

The sensor is configured in a reference atmosphere, such as in the open air, where a source of harmful gases is brought to it. The sensor calibration takes a few seconds, after which it is ready for operation. The robot uses sonar HC-SR04 for space orientation. Thanks to it, the robot can measure the distance to obstacles and objects.

To measure the noise level and to find the source of the sound, a microphone is mounted on the platform in a directional case, which gives a more accurate method of finding the objects that emit sound. The platform also has a PIR motion detector. The use of this sensor made it possible to apply the method of finding an object along a thermal trace while moving the object itself or when the object engages some part of its body, such as a limb. After detecting a living object, the robot approaches it, if it is shallow, and uses

an optical sensor to measure the pulse of the victim. This data is transmitted via radio to the computer of the rescue team operator, who can also contact the person in need of assistance via a negotiating device (which can be further mounted on the platform). An individual first aid kit and individual respiratory protective equipment can be placed on board. After completing all instructions, the operator commands to activate the alarm device, which will allow rescuers to identify the victim faster.

The alarm device is an active piezoelectric and ultra-bright LED. This approach will allow you to look for a victim faster in heavily smoky rooms. Optionally can be equipped with a GPS tracker platform, which in turn will allow you to get the exact location of the rescue object, and the robot will be able to continue the search.

Platform test results.

The following aspects were considered during testing:

- Passability.
- Maneuverability.
- Communication.
- Data transfer.
- Autonomy.

Permeability.

The robotic platform was tested on the following surfaces:

- Sand.
- Soil.
- Asphalt.
- Crushed stone.
- Carpet.
- Linoleum.
- Tile.

Results:

The platform has the best passability on abrasive surfaces [4], such as soil, asphalt, carpet. When tested on the sand on the platform was observed layer of deposits of dust, but no significant change in the operation of the systems did not make. When moving on sandy surfaces, there was a slight burial of the platform, but the use of all-wheel drive made it possible to avoid slipping and jams. When moving on the carpet and linoleum, there were slight slippage moments during the start, but there was no significant effect on the movement of the platform.

With respect to sloping surfaces. The maximum surface angle the platform can overcome:

When starting from the bottom of the platform with full engine forcing - 35°

When accelerating from a distance of 1m with full forcing of engines - 45°

Maneuverability

In the study of maneuverability, the work achieved the following results:

- The full rotation for 360° by engine forcing , with the motors moving in opposite directions.
- Changing the radius of the arc of rotation by changing the speed of rotation of the engines.

- Smooth rotation - 360^0 , provided the motors move in opposite directions and use the ability to adjust the speed of the motors.

Communication / data transmission.

The platform is equipped with two types of radio communication:

HC-06 bluetooth and nrf24l01 + radio module. Data was transmitted via bluetooth. The data from the sensors were transmitted to the terminal on the PC. Stable outdoor data transmission continued at a distance of 30m with an additional solder antenna. The nrf24l01 + module was used for remote control. Stable signal reception was taken at a distance of 60m. In the event of a signal loss, the robot stopped and rode backward until communication resumed.

Autonomy

Work on a single charge is 1.5 hours when driving on rough terrain, resulting in a drive of 1.3 km.

Conclusions

The results of the tests and the work done give a positive result. This confirms the feasibility of using such platforms in search and rescue operations. The advantages of this method are:

- Ability to reduce human risk during searches.
- The ability to reach inaccessible places.
- Ability to provide medical assistance remotely.
- Inspection of buildings with toxic substances, smoke.
- Establishing a person's whereabouts.
- Simple design.

When designing the final device, it will be possible to use cheap and reliable accessories. The very price issue of robotic rescue platforms does not contribute to the dissemination of their ambulance workers. The big advantage of such devices is that they are built on the basis of ARDUINO, which means that such devices can be developed by students of technical universities. The prerequisite here is that it will:

- reduce the cost of the device.
- to provide educational material for students / students.
- to encourage the learning of the languages of programming.
- Encourage students to study and develop materials for device construction.
- to organize work in colleges. Etc.

Literature

1. "Pharmacist Practitioner" # 09 ' 2014. Robotics - Medicine and Pharmacy [Electronic resource] / "Pharmacist Practitioner" # 09 ' 2014. - 2014. - Resource access mode: <https://fp.com.ua/articles/robotics-meditsine-and-farmatsii/>.
2. Robots in liquidation of the Chernobyl accident [Electronic resource] - Mode of access to the resource: <https://pripyat-city.ru/documents/27-roboty-pri-likvidacii-avarii-na-chaes.html>.
3. SCIENCE Snake and Rescuer: Robot created to search for victims in the rubble [Electronic resource] - Mode of access to the resource: <https://iz.ru/918782/aleksandr-bulanov/zmei-i-spasitel-sozdan-robot-dlia-search-postradavshikh-pod-zavalami>.
4. Wheel clutch with support surface [Electronic resource] - Resource access mode: <https://studopedia.info/1-65601.html>.