

Brief information about the project

Name of the project	Development of the humanoid robot Zhugirmek v1.0
Relevance	Currently, the demand for humanoid robots is growing, but most of them are expensive. The Zhugirmek v1.0 project is aimed at developing a low-cost, remotely controlled humanoid robot. This robot can be used in dangerous or remote areas, as well as to enable people to work from home. The project will increase labor efficiency and contribute to the development of new digital work formats.
Purpose	Solving the structural, kinematic and strength analysis of the domestic robot Zhugirmek v1.0 and designing the robot, as well as creating a program for autonomous and remotely controlled robot movement, regardless of the physical differences between humans and robots.
Objectives	The objectives of the project are to calculate structural, kinematic and strength analysis, create a 3D model in SolidWorks for structural optimization and design. Expand autonomous control capabilities using Jetson, Raspberry Pi, Arduino microprocessors. Install a camera with multiple sensors that determine the current location in space, obtain spatial telemetry data and information about the current state of the object, such as temperature, atmospheric pressure, concentration of harmful pollutants in the air, etc. Use a remote control with video communication. After receiving all the necessary data, write articles in the Scopus database.
Expected and achieved results	Expected results of the project: 1. Structural, kinematic and strength analysis of the robot mechanism, as a result of which their structural scheme and joint parameters, direct kinematics and inverse kinematics, working areas, drive torques, as well as the development of a control system will be determined. 2. 2 (two) articles in journals from the first three quartiles in the Web of Science database according to the impact factor or 2 (two) articles with at least the 50th percentile according to CiteScore in the Scopus database, as well as 1 (one) article in a peer-reviewed foreign or domestic publication and one patent of the Republic of Kazakhstan will be obtained. 3. Modeling in SolidWorks for effective 3D design. 4. Design documentation and an experimental prototype of a new humanoid robot will be created using Raspberry Pi, Arduino and mechanical components. 5. A new method for controlling a humanoid robot Zhugirmek v1.0. will be developed. Achieved results: 1. Structural analysis of the Zhugirmek v1.0 humanoid robot was carried out, its efficient architecture was developed; 2. The direct kinematics problem of the robot was solved, the spatial location of the moving joints was determined, and numerical results were obtained;

	3. The inverse kinematics problem of the robot was solved, the parameters of the input joints were determined, and numerical results were obtained; 4. The dynamic model of the robot arm was created using the Denavit–Hartenberg method; 5. The mobile platform of the robot (base with 4 mecanum wheels) was designed and a prototype was built; 6. The robot's workspace was analyzed in the MATLAB environment (workspace analysis); 7. A full 3D model of the robot was created in the SolidWorks program; 8. Experimental tests were conducted on the drive systems (BLDC motor + encoder + driver); 9. Several design options for the shoulder joint were developed and analyzed.
Research team members with their identifiers (Scopus Author ID, Researcher ID, ORCID, if available) and links to relevant profiles	Zholdassov Yernar Nurdosuly, Scopus:H-index 2, https://orcid.org/0000-0002-1221-4474, https://www.scopus.com/authid/detail.uri?authorId=57305684300 Web of Science: H-index 0, ResearcherID: ABD-6982-2020 Baigunchekov Zhumadil Zhanabayevich, Scopus: H-index 5, https://www.scopus.com/authid/detail.uri?authorId=6506823633 https://orcid.org/0000-0002-5807-0541, Web of Science: H-index 3, ResearcherID: AAA-9038-2020
Usage	Service (hotel, reception, customer service); Remote work (the operator controls the robot from home); Hazardous areas (production, chemical environment, epidemic); Education and research (university, laboratory); Medicine (telepresence, patient communication); Security and control (guarding, monitoring); Logistics and warehousing (light transportation, inspection); Social assistance (assistance to the elderly or people with disabilities); Events and exhibitions (guide, presentation); Smart-city systems (integration with city services), etc.
Priority compared to real-world alternatives	At the prototype level, the cost is about 3000 USD, which is several times cheaper than humanoid robots on the market; The ability to remotely control (teleoperation) via the Internet allows the operator to control the robot from anywhere; Focused on specific application tasks (service, inspection, remote work); The ability to move in all directions using a mobile platform (mecanum wheels); The system, the mechanics, kinematics and dynamics of which are calculated at an engineering level; A structure close to the modular principle, allows for gradual improvement of the system.
List of publications with links to them	There is currently no publication.
Patents	There are currently no patents.

