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Proposal of Tracked Robot with Folding Arms

Peter Marcinko*, Ján Semjon, Vladimír Baláž, Marek Vagaš, Rudolf Jánoš

Department of Robotics, Technical University of Kosice, Kosice, Slovakia
*Corresponding author: peter.marcinko@tuke.sk

Abstract This article describes the design of folding arms for service tracked robot. The work is mainly focused on a proposal from the folding arms, which should ensure greater ground clearance work and thereby ensure better cooperation action superstructure work with object manipulation. Further, the work deals with modeling platform robot with endless tracks and also designed with folding arms.

Keywords: *tracked robot, folding arm, 3D model*

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1. Introduction

In the modern era we are increasingly faced with cases in which, at certain places cannot go human. In these cases, they are deploying service robots that are structurally and technically capable of withstanding external environmental influences. The advantages of the systems installed that can detect threats in a timely manner, but also to improve access to the target. For better maneuverability tracked chassis of service robot used folding arms [1,4]. This is an issue of service robotics, which are already a number of publications. Tracked robot during operation may come into contact with various obstacles and therefore must be resolved subsystem mobility. Therefore, this system is viewed from various perspectives. The main objective is to achieve tracked robot to overcome bigger obstacles. Development of tracked robot creating different structural design. This kind of robot used in a complex environment with many obstacles. The diversity and quality of the design is different from the requirements. Great demands are on the drives, design, sensors and communications [2]. These robotics systems find application wherever the environment is dangerous for human beings or restricted. Often are fitted with handling devices or trays. Can perform the role of transport, handling, safety interventions etc.

2. Analysis Tracked Mobile Robot

These mobile robots used a subsystem mobility which is based on tracked. Technical practice bring a lot of structurally and technically solutions of subsystem mobility. Therefore tracked robots may be used in special service activities. There is a simple variant with two belts, but also variants that combine wheels and belts. Requirements for these service robots are different.

Crucial as high load capacity, low weight of the entire robot, robot dimensions, characteristics and dimensions of the belts, engine power, construction, maintenance of systems, etc. Some types of tracked mobile robots are shown in Figure 1 [3,4].

Tracked robots are used for more demanding operating area, for example:

- in health,
- construction (launcher),
- army,
- nuclear industry (for the handling with hazardous materials),
- agriculture,
- forestry,
- special research (underwater or cosmic),
- security services (anti-terrorism, rescue, firefighting).

Figure 1. Types of tracked mobile robots

2.1. Tracked Model

Tracked chassis are shown in Figure 2. This kind of tracked chassis consists of several parts and these are shown in the same picture [5].

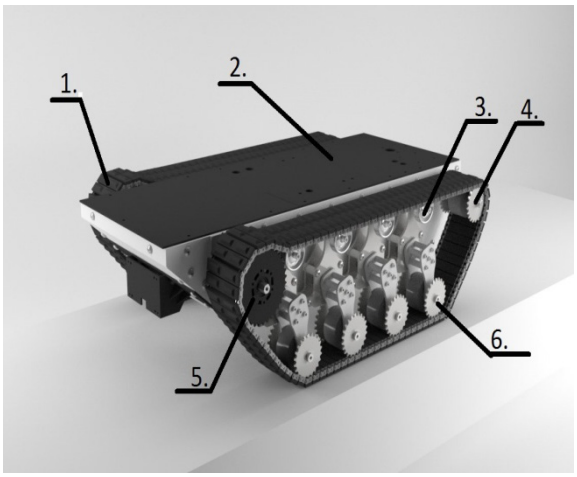

Figure 2. Model of tracked robot

Parts:
• **1. Belt** - belt realized by the inner side belt transfer power required for the robot and by the outer surface of the belt is realized by ground movement, determines also features traction,
• **2. Platform** – serves as supporting part of the whole system, on platform consolidate the different parts such as sensors, robotic arm etc.,
• **3. Track adjusting wheel** – these wheels are guaranteed belt tensioning,
• **4. Driven wheel** – this type of wheel is not connected to the drive, ensure chassis rigidity,
• **5. Driving wheel** – drive to initializes the movement of the drive wheel,
• **6. Guiding wheel** – their role is to provide leadership belt and also guarantees contact with ground.

In compiling tracked for mobile service robot are important the primary elements of the chassis frame, the engine and the number of modules belts. Also important are secondary elements such as types of wheels, axle types, but also the article of tracked. Combined primary and secondary elements formed various structures.

There are several types of tracked like the classic module, folding module or combined module with folding arms, but in this case using double module with folding arms.

Double module used folding arms by side platform. This module is parallel, single breasted, double layer, one wheel and double belt. It is suitable to broken country with stable or solid surface or flexible surface. The surface may contain larger the height difference between the obstacles [6].

2.2. Basic Parameters of Platform Jaguar

The basic concept forms the Jaguar platform, which is designed for exterior and interior. This platform is weather a water resistant enclosure. The benefit is high maneuverability. Primary belts are powered by two independent motors. Specific type is Jaguar Lite and it means that the tracked platform equipped with only two engines to power the primary tracked, without electronics. Features of this platform with fully equipped is presented in Figure 3 [7].

For the tracked robot designed simple constructions and reliable folding arms. It was necessary to propose a mechanism for driving the tilting of the arms. Appropriate solutions were collected from several concepts.

Using of multi-criteria analysis to select the most suitable variant, which should ensure the smooth running over obstacles. This proposal should be in accordance with the requirements as structural sophistication, system maintenance, system performance, software and hardware versions and values [8].

The most suitable concept includes a tilting drive inside the robot. It was also considered for the drive in the folding arm. Whole mechanism is based on hollow shaft, Figure 4.

This proposal is structurally difficult, because the shafts must be securely stored in the system of bearings and plain bushes. Whole system is stored in the platform where there is plenty of space on their placing.

Features	Description
Dimensions	640x 538x176
Operating weight	9,5 kg
Terrain	Sand, rock, concrete, grass, soil and others wet andy dry
Speed	0 – 5,5 km/hr
Stair climbing	Max. stair step height 180 mm
Other	RC controller, camera, sound, lighting, ethernet, GPS modul and many other accessories

Figure 3. Features of platform Jaguar

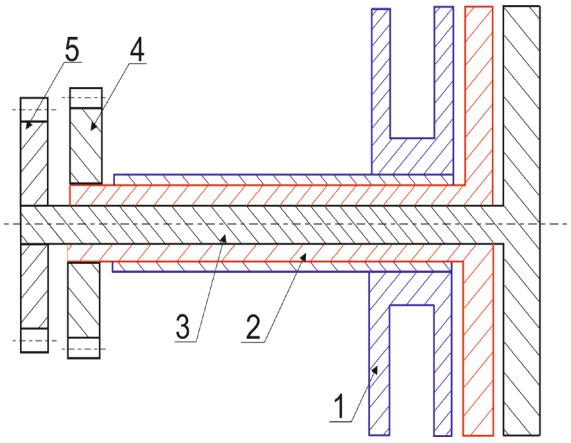

Figure 4. Concept hollow shafts

Parts of this concept:
1 – driven wheel of the main belt mounted on the first hollow shaft,
2 – hollow shaft with folding arms,
3 – shaft, which transmits torque to the wheel of folding arm,
4 – gear, which transmits torque on folding arm,
5 – gear, which drives the driving wheel of folding arms.

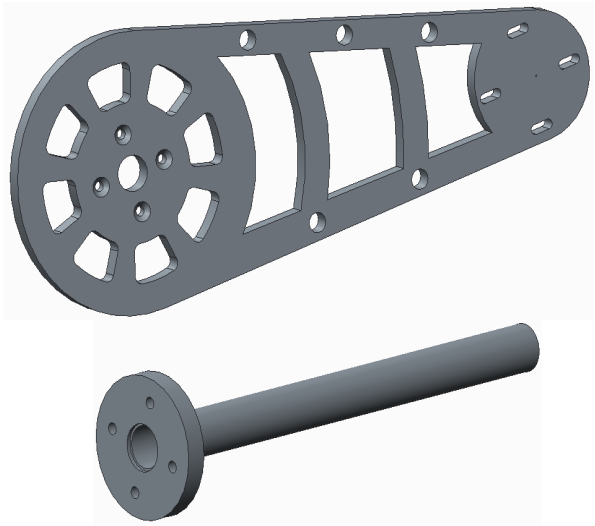

Figure 5. Folding arm with shaft

2.3. Folding Arm

Torque of the drive is transmitted through the gears on the shaft. At the end of the shaft there is located flange. With the screws shaft is fixed to the arm. This mechanism is shown in Figure 5.

The whole system consists of a driven wheel, driving wheel, guiding wheels and through the lock ring, bearings and screws are put together complete tilt system. This optimized platform should with setting different angles of arms to overcome different types of barriers for example stairs, curbs and different terrain roughness.

In the design of structure it is necessary to take account of technical and economic parameters. Locomotion system consists of two primary belts. These are mounted directly on the basic platform. Two secondary belts are mounted on folding arms. Arms are made of aluminium (Type: Al 6061) and are therefore easily and securely [9]. Normalized tracked is used as the energy carrier.

Belt realized by the inner side belt transmission power required for the robot and using the outer belt surface realized move around the terrain. Belt on folding arm has a width of 20 mm. This belt is double – sided [10].

3. 3D Model

The platform itself without folding arm should problem with overcoming obstacles. It is therefore necessary to solve this problem arm that would leaned obstacles and helped overcome obstacle. If the arm tilted to the angle 135 degrees it should ensure a smooth transition of obstacles. If the folding arms get on the obstacle, the next tilt and balancing of the arms ensures smooth progress over obstacles.

Basic design of the device itself is a frame which is formed by sheet metal. The chassis consists of two tracked by the sides. On these belts is torque transmitted from two independent motors. Extended construction of the folding arms has several advantages [11].

The primary engines are stored on the back side of platform. On the opposite side is ample storage for engines of folding arms. For tilting the proposed two engines that are independent of each other and they are able to move 360 degrees. One motor is designed to drive the driving wheels of folding arm.

On this arm are used two pulleys. It is a driven and driving pulley. Larger pulley is driving that is attached by means of clamping sleeve. Smaller pulley is mounted on the flange. Flange and pulley connects bearings. The whole mechanism is secured by a screw and washer. On the arm are located the holes that reduces overall weight. On the lower and upper part there is a holes that serves to attach the guiding wheels. On the smaller part a hole into which attaches the flange. Using this flange is to tension whole system of folding arm.

The pulleys have pitch spacing 8 mm and the width of space to accommodate the belt is 20 mm. Material from which is manufactured pulley is a steel. To ensure smooth operation is necessary to separate the shaft bearings. As this is a very small space between the shafts and were used plain bushes. The plain bushes are made of composite material PTFE. These plain bushes have a teflon layer and used in combines high driving speeds. This is a dry bearing [12].

The next Figure 6 is a tracked robot with folding arms in multiple positions. In second and third position of the folding arms should the robot already be able to overcome more complicated barriers.

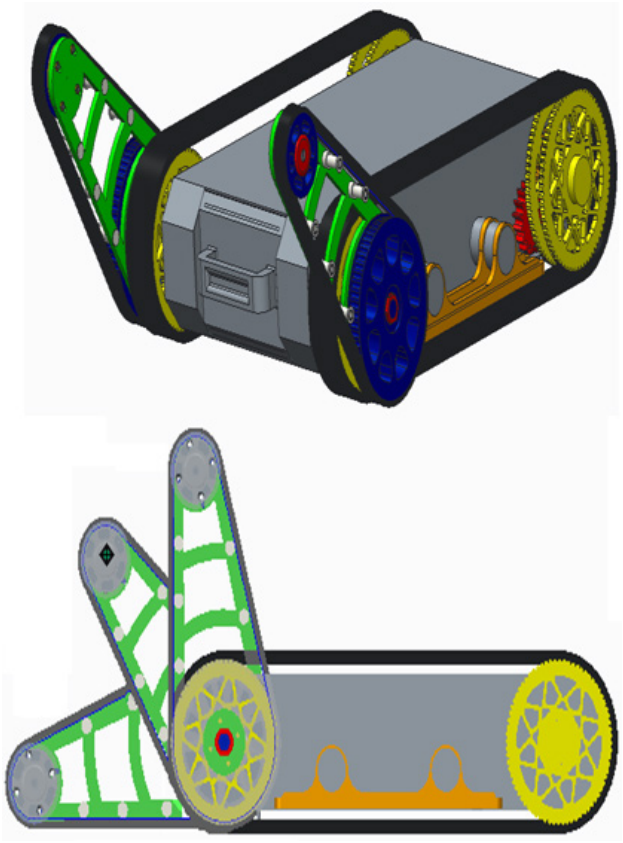

Figure 6. Multiple positions

Advantages of plain bushes:
- system maintenance free,
- low friction,
- high speed,
- the possibility of producing customized.

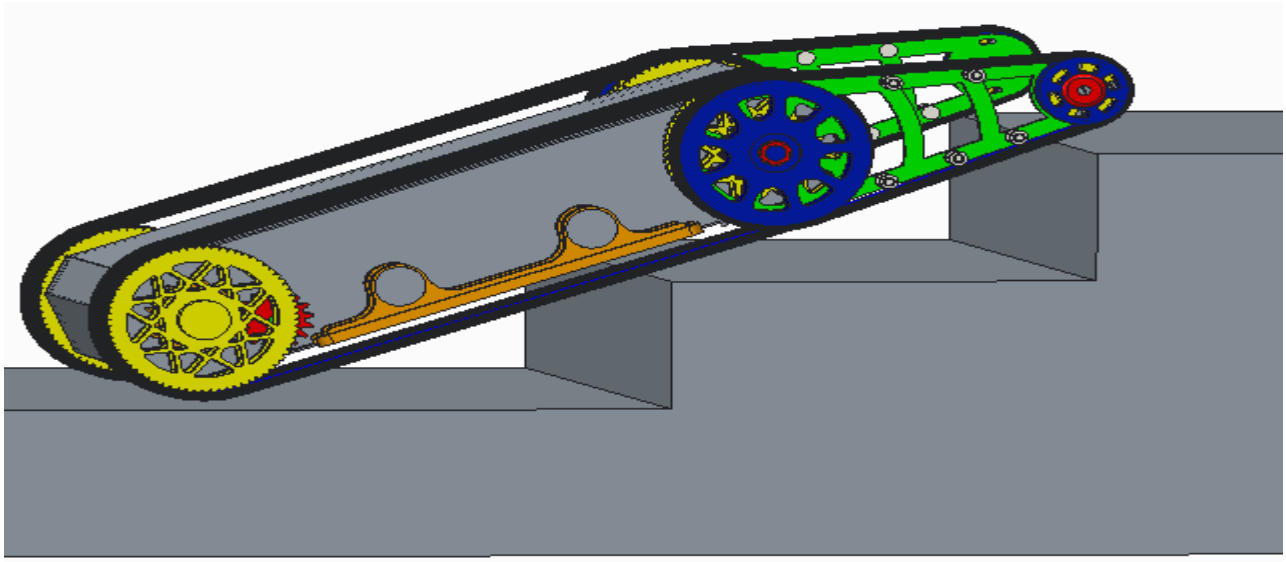

Figure 7. Tracked platform with folding arms

Figure 7 illustrates the application of tracked robot Jaguar Lite with folding arms on the stairs. In the case of tracked platform with proposed arms should overcome obstacles without any problems. This proposal can vary depending upon the application, especially as regards the pulley and tracked.

Acknowledgements

The main aim was to design a folding arm for tracked platform Jaguar. In this case were designed folding arms, which may move in 360 degrees. These arms could be used to overcome various obstacles on the ground or in buildings, or some kind means of communication.

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