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PROPOSAL OF TRACKED MOBILE ROBOT WITH FOLDING ARMS

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Abstract: This paper deals with mobile robots, specifically on tracked mobile service robots. In this case deal with the design of folding arms. These arms should help the mobile platform in overcoming obstacles. For creating the basic model was used platform Jaguar. For this platform were designed folding arms and parts of the tilting mechanism. Model is represented. Advantages of the service robots are installed systems that help realize operations. It can be a system that helps handling or early by detecting threats or to improve driveability. For better passability tracked mobile robots proposed various improvements such as folding arms. Tracked robots have different versions of the subsystem mobility. This type of tracked robot used in the complicated places, which have many complex obstacles. Great specifications are on construction, sensors, design and communication interface.

1 Introduction

Nowadays, modern technology helps us in everyday life at work or at home. In practise, we faced with a situations when in certain places cannot go person. Most of these places are dangerous for human health. It is a place, for example in nuclear plant or hardly accessible terrain. In such situations it is necessary to deploy mobile service robots. These kinds of robots should resist the action of the external environment in which they perform service work [1]. Advantages of the service robots are installed systems that help realize operations. It can be a system that helps handling or early by detecting threats or to improve driveability. For better passability tracked mobile robots proposed various improvements such as folding arms. Tracked robots have different versions of the subsystem mobility. This type of tracked robot used in the complicated places, which have many complex obstacles. Great specifications are on construction, sensors, design and communication interface.

2 Subsystem mobility of tracked mobile robot

Mobility system performance may be different. It is a structure that uses as a basis tracked vehicle. In practise we can meet with different versions [2,3]. Utilization different quantity of belts, but also combinations of wheels and belts (Figure 1).

Figure 1 Types of subsystem mobility

Analyse for tracked service robots has demonstrated that these types are used in difficult conditions, for example:

- army,
- forestry,
- agriculture,
- construction,
- nuclear industry,
- security service (rescue, anti-terrorism).

From the knowledge gained from experience, which is the space in which the robot can move and perform service work may be described as kind:

• **Work environment:**
- horizontal (stairs, inequality, …),
- vertical (houses, flats, …).

• **Types of surfaces:**
- urbanized (stairs, path, …);
- standard natural (grass, surface, soil, …),
- exacting natural (snow, gravel, …).

On tracked service robots are placed different demands. Among the most prominent requirements include:
- proportional size (around the robot chassis, width – length – height),
- heavy duty (construction robot should meet high stability even when carrying out service work),
- low weight (this feature should be guaranteed, the lower the contact pressure, respectively landscape, after which the robot should move),
- sizes and types of belts (it should consider the type of belt for specific service activity as well as belt dimension),
- chassis design (the structure itself should be resistant to external environmental influences),
- drives (should be recalculated and then choose the drives that would ensure continuity of operation of the device and would be saving on energy consumption),
- maintenance (maintenance of the entire system should be simple and fast).

2.1 Model of tracked robot

Chassis are composed of several assemblies and subassemblies [4]. These parts are shown on (Figure 2).

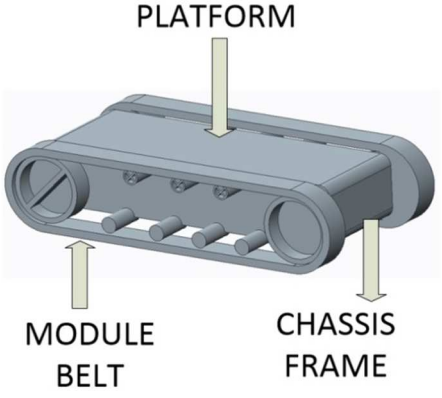

Figure 2 Model of tracked robot

In this article deal with the module belt, which consisting of some general parts that are described in (Figure 3).

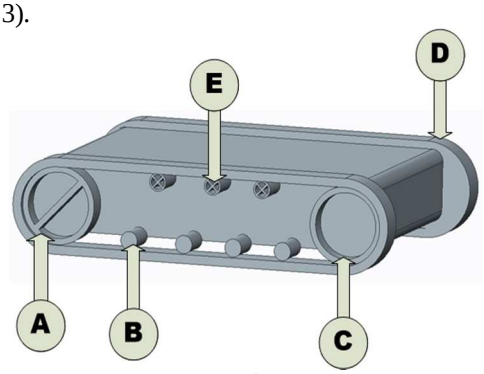

Figure 3 Parts of module belt

Parts of module belt:

A – Driving wheel – drive initializes the movement of the drive wheel,

B – Guiding wheels – their role is to provide leadership belt also guarantees contact with ground,

C – Driven wheel – this type of wheel is not connected to the drive, ensure chassis rigidity,

D – 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,

E – Adjusting wheels – these types of wheels are guaranteed belt tensioning.

In compiling belt service tracked robots are primarily important elements such as drives and their strength and quantity, types and quantity of belt, type of frame. Secondary elements are important too, for example: quantity of axles and types, types of used wheels, type of belts. Compiled concepts are described by different properties locomotion as well as various parameters of traction. In practise, the use of many types of modules belt, for example:
- standard module,
- starting module,
- folding module,
- double module with folding arm,
- combined module with folding arm,
- special with two folding arm.

3 Platform Jaguar LITE

The basic version of tracked chassis consists of platform Jaguar Lite. The tracked robot chassis is designed for external or internal operating environment. The advantage is high manoeuvrability [5]. The chassis is equipped with two primary belts and powered ensure by two independent motors without control elements and electronics. In (Table 1) shows the basic parameters of the tracked platform [6].

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Table 1 Parameters of Jaguar LITE

Parameters	Characteristic
Weight	Max. 10 kg
Dimensions	640 x 538 x 176
Max. speed	5,5 km / h
Climbing	Max. 180 mm of stair step
Terrain	Rock, sand, grass, soil and wet or dry terrain
Possibilities	Camera systems, GPS module, other controllers or sensors, Wi-Fi or Bluetooth module and more other accessories

For this tracked chassis was chosen as the most appropriate module with dual folding arm [7]. It consists of folding arms which are imposed on the primary side of belt. The drive kit is a one-wheel, two banded, double layer, parallel and single row. Use of such a module is no longer for more complex terrain with major obstacles. Schematic views of the mechanism (Figure 4).

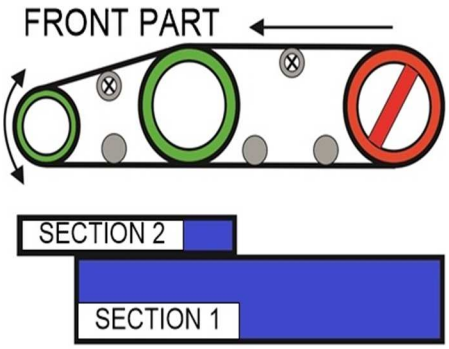

Figure 4 Module with dual folding arm

Section 1: a main belt contains a front wheel, which is driven by a rear wheel, which functions as the drive. The upper wheels serve to lower the tension and act as guiding wheels.

Section 2: rear wheel drive works as a front a driven. On the folding arm is fitted with guide wheels.

Using multi-criteria analysis will select the most appropriate variant, which should ensure smooth over obstacles. The analysis should include criteria [8]:

- construct,
- maintenance,
- reliability,
- power of system,
- software and hardware,
- economic factor.

Among the many variants can be chosen as the most suitable alternative with folding unit, located in the basic tracked platform. It is also possible variant including a drive unit in the folding arm, but the execution in terms of the economic factor increased the cost because of more expensive drive unit.

The selected device is made up of a number of shafts. The proposal is structurally complex because the shafts must be securely stored in the bearings and sliding bushes. The whole mechanism is mounted in the platform where there is enough space to store. System of the tilt arms (Figure 5).

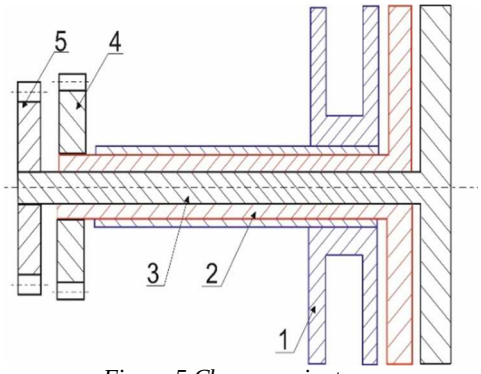

Figure 5 Chosen variant

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.

4 Folding arm

Torque from the drive is transmitted through the gears on the shaft. At the end of the shaft is positioned flange. With screws, the shaft is attached to the folding arm.

The whole system of the folding arm consists of several parts. Driven wheel, guiding wheel, ajusting wheel, driving wheel, screws, shafts, bearings and slide bushes. This extended platform of these arms would be throguh setting defiierent angles of arms, overcome difeerenet kinds of obstacles, for example: stairs, curbs and various terrain.

When the design must take into acoount the technical and economic parameters. Locomotion system consists of two primary belts, which are mounted directly to the base platform. The two secondary belts are arranged on the folding arm. The arms should be making less weight, sketching possibility of using alluminium as a material [9]. The belt carriers out the inner side torque transfer the drive and use outside move the terrain.

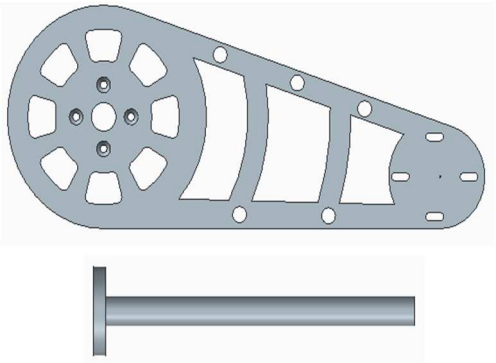

Figure 6 Folding arm

4.1 Model of tracked robot with folding arms

The basic structure of the actual mobile robot is a frame that consists of sheet metal. This basic is complemented by two primary belts on the sides. For these belts, the transmitted torque of the two independent motors. Extending the platform has several advantages. The primary drive is stored on the back of base frame. On the other side, plenty of storage sprace for the secondary engine folding arms. For tilting proposed two engines, also independent of each other, which can be tilted 360º. One motor is intended to drive the driving wheels of folding arm.

On the arm of the two pulleys are used. Larger wheel is driving, shich is connected by a clamping sleeve. Smaller wheel is stored by bearing on the flange. The entire device is secured screw. To arm the coutouts which reduce the total weight. The lower and upper openings are located, for fastening of the guide wheels. On the naroower part of the openings to contain the flange of the driven pulley. Using the flange being stretched folding arm the system. Pulleys have a pitch of 8 mm and the width of the bearing strip is 20 mm. For production of pulley is used steel.

The ensure the smooth running of the mechanism, it is necessary to separate the storage shafts. It is small space, used a plain bushes. The selected bushes are made of a composite of PTFE. These bushes have a layer of teflon and are used for high speed. The advantages of plain bushes:

- high speed,
- low friction,
- maintenance free.

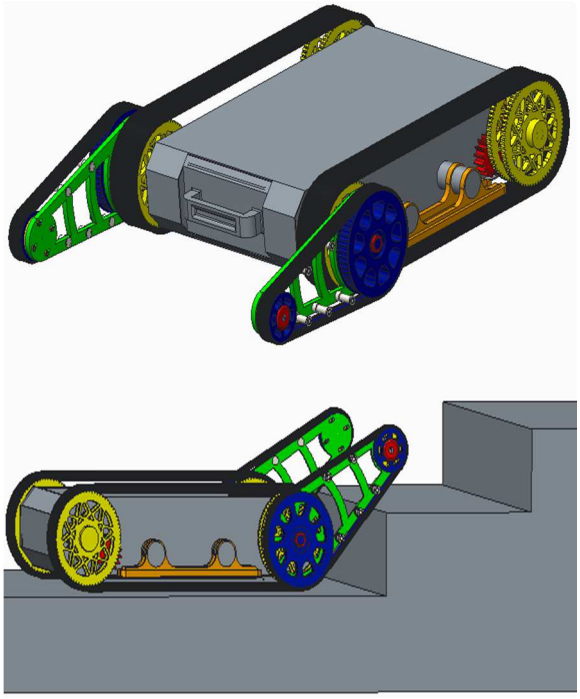

Figure 7 Extended platform

Shows a tracked platform with proposed folding arms, which can be tilted to various positions. Example which makes use of folding arms (Picture 7).

Conclusion

The aim was propose folding arms for belt chassis Jaguar LITE. In this case, the proposed arms, which should meet the requirements for more complex overcoming obstacles. The actual tilting arms should be independent to the service robot to avoid various terrain. This modified chassis could be useful for inspection activities in buildings or in vehicles.

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