PERFORMANCE ANALYSIS OF ROBOTS: A REVIEW

Abstract

Robotics being a major community in the upcoming progressive terminology of modern era, it plays an important role in cutting down manpower in certain areas. Nowadays robotics is being utilized in numerous areas and is playing effective and beneficial role in the respective. In this paper such kind of walking robots are being discussed whose presence makes things easy for humans specially certain jobs where manpower is excessively needed. Manpower being utilized to uplift things or transport things from one place to other can be minimized with the help of these walking robots which are meant to carry loads and transport them from one place to other. In this paper comparison of different models and working terminologies of robots are introduced in order to find the best amongst them and work further on their development and further processing to enhance their characteristics. Modern Robotic era plays with the signs and sight of work load reduction and enhancing work as well outcome efficiency for better results. In this paper comparison of legged, wheeled and track robots are shown according to their performance with respect to the working conditions and specifications of robot. Walking robots are the new trends in modern era as it is based on the sensors as well optimized setup where system acts and interacts according to the users command. Robots under such categories are very useful where performance of other system is not effective.

Keywords: rawler, Robot, Machine, System

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I. INTRODUCTION

Transportation of things from one place to another is the most attractive part of any robotic set. Walking robots performing these tasks are the most awaited robots in industries where robots have total control over things and chances of mistakes being reduced. . Terminology walking robot terms to the bots which are specially programmed or controlled to transport things from one place to other which may be in plane, rugged surface, uneven terrains or slope and stairs. Working conditions and circumstances may affect the performance of bot as some are meant for better planes and some are for slopes and stairs.

II. METHODOLOGY

1. **Legged Robots:** Ceccarelli and Figliolini[1] presented the system robot EP-WAR2 which use electro-pneumatic actuators and suction cups for movement. In order to climb the stairs robot relies on an open-loop control algorithm implemented as a finite state machine. Here the system relies on predefines sensed and calculated motions where terms like height of stairs and steps to be taken at angle are preprogrammed or sensed with the sensors to actuate the movement. Main limitation of this approach is while operating in a different staircase it necessitates manual recalibration. These robots are sensor based system where sensors act as primary sensing elements which inhibit the distance and altitude the robotic leg has to move. Systems related to this methodology are preprogrammed and are assessed with general configurational data which is taken as elementary basic on which the whole system works. Engineers working on this kind of robots generally configure the system with either six leg or eight legs which helps in attaining the mobility as well maintaining the balance of system in ultimate working plane.

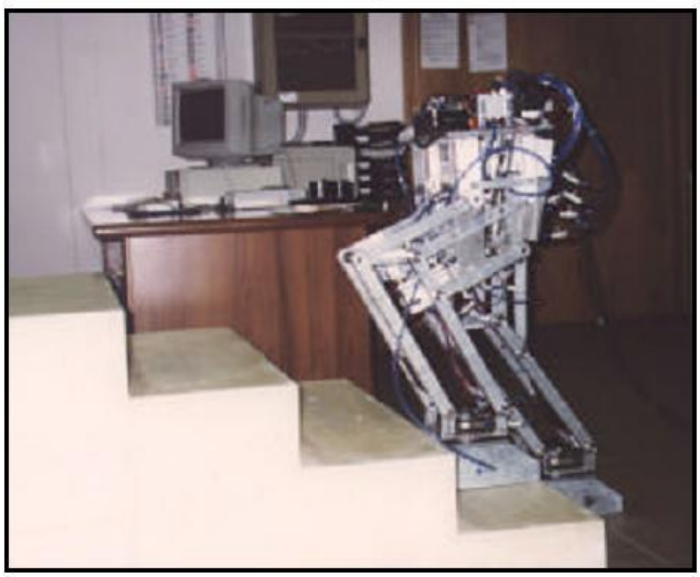

Figure 1: Legged Robot

2. **Wheeled Robots:** Wheeled robots usually have way out to mechanic extension to overcome steep stairs. One application of such technique is patient remedy where stair climbing could greatly improve mobility and thus quality of life of people restrained to wheelchairs. Wheeled Robotic scenario play very crucial role in the current perspective of

loading and unloading, transportation from one place to another and lifting goods from lower to higher ends. Wheeled system attains stability in planes and have are less complicated compared to other two systems in terms of design, manufacturing and controlling by user end. These systems are controlled from user ends and are moreover wired as well wireless systems which enhance the working capability of the system. Wheeled robots work on certain set of wheels that may be either combination of wheels or set of single dimension wheels which is totally dependent upon the working circumstances and the purpose of system as well user desire. [2]Wheels with proportionate dimensions are most famous in the working scenario of wheeled robots as it provides better contact as well work ratio and enables the system to work under required working ratios and maintains the desirable sustainability of system. Set of Wheels with distinguish wheel ration are taken in concept when special purpose robots are designed regardless of their working as well operating scenarios. These machines are capable of working in different terrains with better efficiency and enhanced programmed systems which enhances the working quality as well specification of work according to the requirement. These are termed to be the most basic and effective bot in the robotic system as its working configuration and system ability is moreover simpler and easy to configurate than other systems. These system can work efficiently in planes, slopes and hinged areas, as they move towards stairs and uneven terrains these system need more functionality and time and are more complicated to design, function and control as wheels need to be configured according to the terrain and ration of working circumstances and wheels changes hence it becomes more complicated to handle these systems in such terrains and are moreover costly and hassled working system.

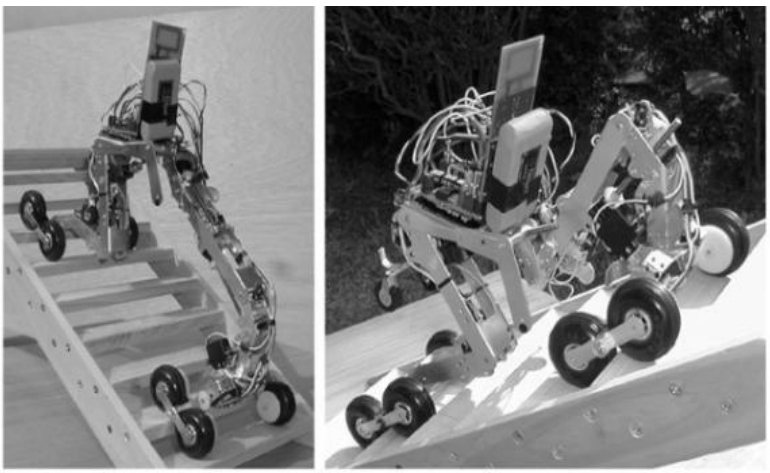

Figure 2: Wheeled Robot

3. **Track Robots:** If tracked robots are compared in terms of having surface contact with ground, these always come out to be best as compared to the wheeled and legged robots because track belts cover full surface. They are much more in contact with working surface and produces better frictional effects while driving robot in uneven and steep stair terrains. In terms of stability also, track belt robots are better than bipeds because of their low center of gravity and more suitable than wheeled robots due to their stability to attain the position in which they are working. Liu-et-al[3] derived the fundamental dynamics of the stair-climbing string for a tracked robotic factor analyzing the various states of robot climbing and working in various states and terrains, nose crossing, nose line climbing and

the effects of grouser bars or cleats. The analysis is limited to certain model and slippage of track belt, vibrations in belt during movement and edge retention and intermittent loss of track-surface contact phenomena that are commonly encountered during stair climbing are neglected. Track belt robots are the future of moving robots because of its functional diversity and easy working dimensions and parameters as well. These systems are easy to handle and actuate as these consist single tracked set of movers which are better and easy when it comes to working scenario as well functionality and controls from user end. These inhibit set of track belts which are responsible for the motion of robot. These set of track belts provide better frictional grip to the system and inhibits the property of easy slope as well stair climbing scenario for the system. Belts provide better surface contact to the system which enables stability and sustainability of robot and allows it to move in different terrains with better surface contact and less slippage as well diverting the system away from the tack or path. Variety of Track belts increase the functionality of system according to the path or terrain it is operating in. These belts are moreover responsive for attaining better motion of system in distinguished terrains.

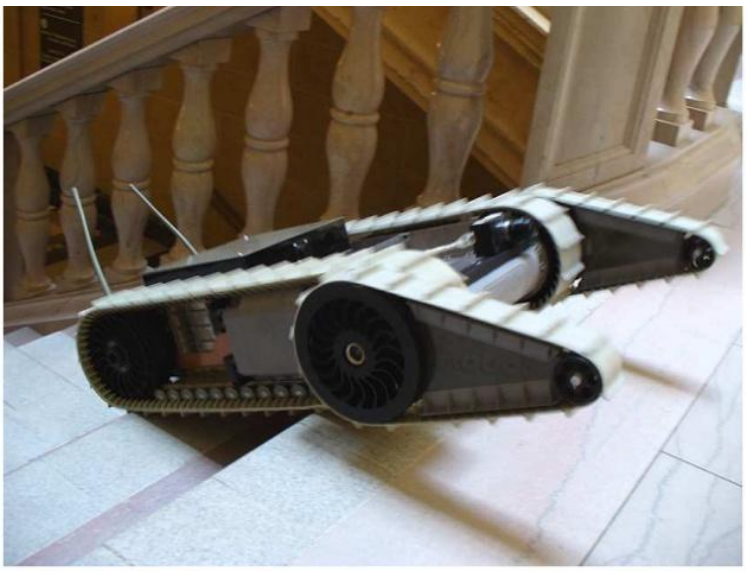

Figure 3: Track Belt Robot

III. COMPARISON OF THE WORKING ROBOTS ON THE BASIS OF CERTAIN CRITERIA

1. **Static Stability VS Dynamic Stability:** A supreme legged locomotion robot [4] is statically stable at time if all legs are in contact with the support plane at the given time and remain in contact with the plane when all the legs of the machine are fixed at their positions at certain time and the translational and rotational Velocities of the resulting body are simultaneously reduced to zero.

In case a robot is allowed for to come remote or away its centre of mass from the support area, then there should be some way which needs to be find out for compensating this by its performance, for example movement of its foot or center of mass. The robot cannot stop its movement simply or it cannot just slow down its movement for a definite time because it is forcefully allowed for compensating its balance so that it remains

steady. It can be stopped or slowed down or allowed to change its motion in any way for a short time period but that means the robot has to complete the motion quickly.

2. **Performance in Terrains**: Performance of robot depends on the terrain in which it is operating. Generally flat or plane surface is kept as base for movement but in certain special circumstances uneven terrains and steep slope or stairs can be indulged for operation. [5]Certain robots are manufactured to work under different circumstances and different terrains. Type of robot to be functioned can be decided according to the terrain we have. Certain robots show better performance in plane and slope but they falls back when it comes to stair and uneven terrains. Hence to extract the best functionality of robot they must be specified according the terrain and job t be performed. Terrains and jobs may differ for different setup hence an environmental conditional system should be opted keeping the working circumstances in mind.

3. **Movement:** Movement of robot is determined by user end as per the need of operation and the particular direction its motion is taking place. Certain movements like turning at an angle and moving towards inclined surface with inclination, stand turning, rotation of complete system, forward backward movement and left right as well terms the major decisive factors for selection of robot for a particular terrain and enhancing the working conditions for the respective.

4. **Cost:** Cost included in manufacturing the system depends on how the system is designed and what is the purpose of the system. Terrains and working conditions affects the exterior functions of system which showcase the sensing and motion decisive devices and followers for driving system. Loads affect the efficiency of robot as well motor and accordingly driving criteria's are qualified. System cost depends on how much work is carried out on it whether it is software, hardware or machining cost. It indulges the overall cost analysis which shows the whole system cost, its functioning cost, maintenance and machining cost as well. For different type of system different setup and components are required which alters the overall cost of system.

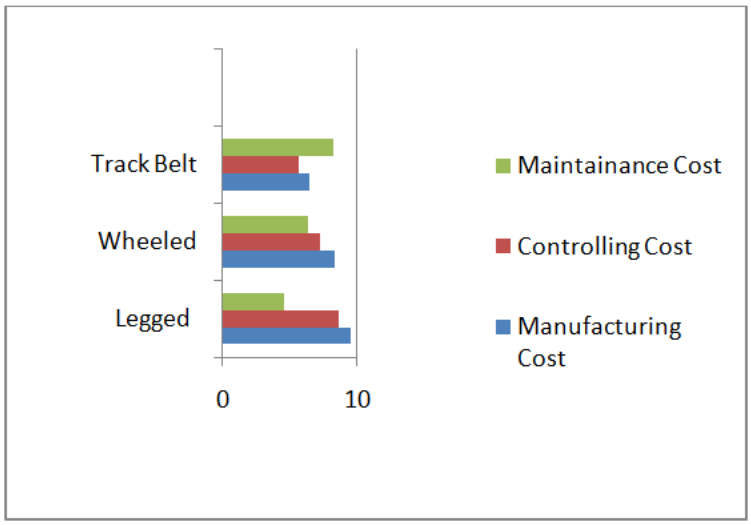

Figure 4: Cost Analysis of Robots

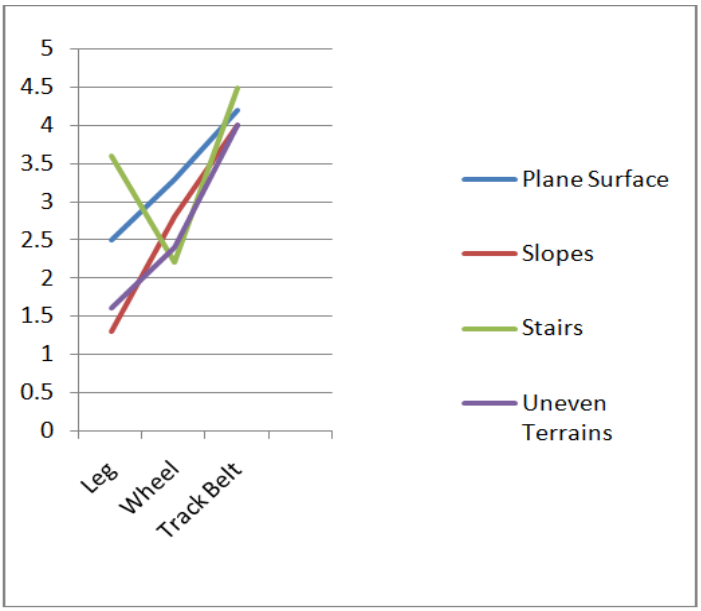

Figure 5: Movement in Different Terrains

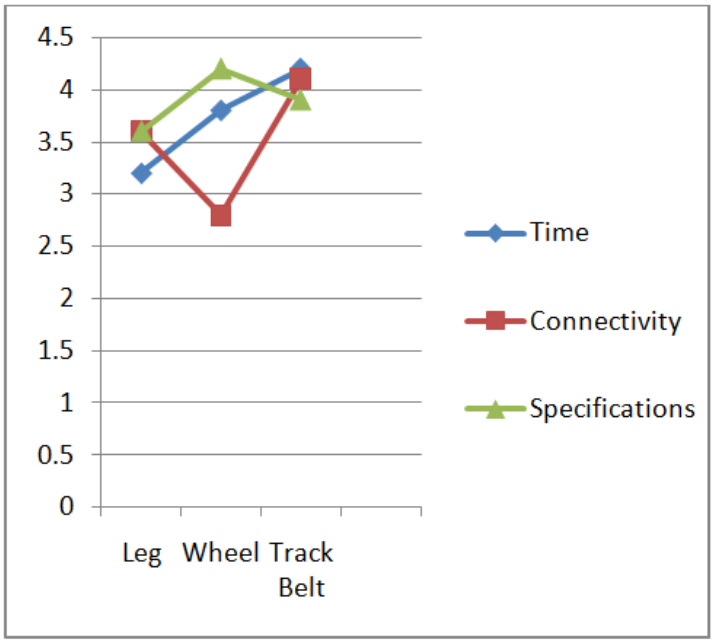

Figure 6: Performance Affecting Factors

IV. CONCLUSION

The reason behind varying range of methods and technologies of movement of the robot is that each method has few advantages and disadvantages. Therefore, no method can be said as best method because there are many vast applications possible for the mobile robots.

Generally, wheels are said to be having greater energy proficiency as compared to legs on the surfaces which have traction of high quality. Wheels are also cheaper than legs because of their simplicity in design and less movable parts. Due to this, low level tasks become easy like affecting forward and steering minor simply but this cannot be done while using legs.

This paper presents a robot which shows that legs can enable a robot to decide that where it can put its feet which helps it to move in rough terrain, as compared to the wheels which can roll over any surface and gets stuck if they are unable to roll over the barrier surface. In some areas, generally there are few parts in the ground that have smooth surface so that a smooth grip is provided whereas remaining surface can be very rough like rocks or it can be too soft like mud. This shows that a legged robot has the advantage of navigating through this type of surface if it is able to select the place for putting its leg as compared to other robots which move their legs in a fixed boundary. But this is a difficult task.

Track Belt robots are the most affective machines when it comes to uneven terrains and surfaces like slopes and steeps or stairs, as they posses more contact with ground and inhibit better frictional forces, gripping efficiency of these robots are higher than other two and are profound to sustain better ability to climb and move around uneven terrains with high efficiency and with easy working factors and less wear ratio than other. These kinds of track robots are useful in areas where stability of other is less and they are not found suitable for the area. Track Robots provide better enhanced working circumstances and ability to tackle the obstructions in the path.

Enhanced Robotic System nowadays provides better working and operating conditions for the system as well increases the functionality of these systems with better outcome and easy way to control them. Inter disciplinary act robots are trending because of easy controls with better communication and working efficiency and are found to be more user friendly and economic than the previous ones.

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