

The Four-legged Loaded Robot Design Based on MCU Control

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Abstract. Based on the bionics, using MCU as the controller and the steering gear as the driving components, Combined with various sensors, makes a flexible, inexpensive, large load ability four-legged robot. The article introduces the constitute principle of the system, analyzes the system working process and its application prospect.

Introduction

Along with the advance of science and technology and the rapid development of computer technology, the robot technology is more and more gotten attention. All kinds of robots are going into our life, Undertaking a variety of tasks in our life. Robot technology has obtained certain achievements in recent years, and the robot research is now one of the most active fields. Research on mobile robot is a hotspot in the field of robotics research. The mobile robot instead of human beings in a complex and dangerous work environment (such as the coal mine, plant) needs more and more attention. General mobile robot can be divided into three types: air robot, underwater robot and the ground robot^[1, 2]. Ground robot development is mainly use the tracks or wheels. Wheeled and tracked robots can work on relatively flat ground, but most of the work could not be achieved on the uneven ground. Compared with the wheeled robot, crawler robot, walking robot feet can cross a larger obstacles, through the soft road, with a strong environmental adaptability and flexibility, used in engineering exploration survey or military reconnaissance and people can't do or dangerous work. It Still can develop into a home service robot or entertainment robot. Most of today's robots are not very mature, especially the walking stability, complex ground resilience and speed, they are still not very ideal. The research of walking steadily on the complex ground is the key of the robot.

At present, many robots have one, two, three, four, six or more degrees. The quadruped walking robot is a important branch of the robot. The quadruped walking robot has simple structure than 6 feet or 8 foot of walking robot, The carrying capacity and stability is better than two-legged walking robot, so it brought to more attention of the researchers from all over the world^[3], International. In 1960, the Shigley proposed linking mechanism was adopted, including four bar mechanism, cam mechanism, the scaling mechanism, as the motion mechanism of legged robots. The movement of the leg is controlled by a set of double rocker mechanism. McGhee and Frank produced a robot called "Phoney Pony quadruped robot" in 1966. This is the first vehicle of the leg, walking under the control of computer independently. Each leg has two degrees of freedom system(DOFS). it can carry on the simple crawling movement, and depending on selected state diagram of diagonal trot. The United States developed quadruped robot "first generation BigDog in 2005". The second generation of BigDog development in 2008, BigDog can walk in 30 degree slope, with the speed of 1.8 meters per second. Domestic, Tsinghua University in 2003 developed Biobot (bionic robot), this paper put forward a comprehensive CpG network topology structure based on Matsuoka oscillator. In addition, it realize the conversion between rhythmic movement and synchronous state. Other universities and research institutions also have developed a quadruped robot, for example, Chinese Academy of Sciences Institute of intelligent machines report by the name of Northwestern Polytechnical University Development for TIM1 imitation mammalian quadruped robot. Also, a large quadruped robot driven by the power is developed by the Institute of the Chinese Academy of Sciences Institute of automation.

Although it has made great achievements in the field of robotics, the robot is still far behind the bionics. The quadruped walking robot research is mainly reflected in the convenient control, small volume and convenient carrying and so on. It is far from the requirements of high load, low energy consumption between the requirements of larger, practicality in the complex operating environment difference. Based on this, research on walking mechanism of low energy consumption, the load ability of the quadruped robot is an important direction. In this paper, a kind of the quadruped weight bearing robot based on MCU control can walk stably on the complex surface and can effectively undertake greater load.

Design of system

The four legged robot Based on MCU control is composed of five parts, the aluminum body, the MCU control module, the four legs, the carrier plate and the obstacle detection module. The MCU control terminal is used to coordinate the overall motion. The overall block diagram of the robot is shown in Fig 1.

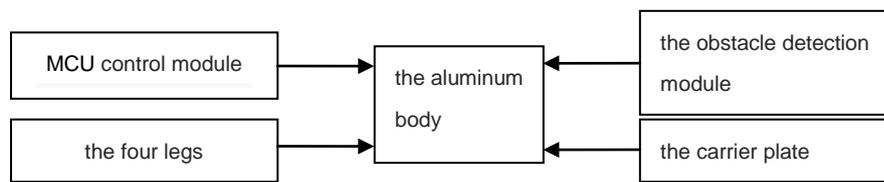


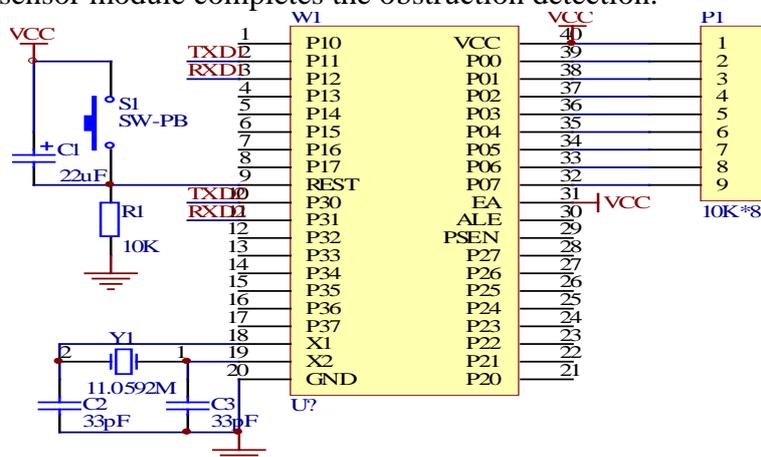
Fig.1 The overall system block diagram

The fuselage design

The main considerations of the material selection of the robot are: easy to use, low cost and easy to process and assemble. Robot material is to achieve certain rigidity and hardness to ensure the assembly to stand up and do not tremble, in the process of walking to maintain the overall stability. Finally decided to use aluminum plate to do the body by reference to a large amount of information [4].

MCU control terminal

The MCU control module is the core of system. The device used AT89C52, high density non-volatile storage technology production, compatible with standard MCS-51 instruction system, is a low voltage, high performance CMOS 8-bit microcomputer. It contains 256 bytes of RAM and 8k bytes of Flash ROM, a piece of built-in Flash memory cell and 8-bit CPU, the single-chip microcomputer is widely applied in electronic industry. Minimum control system as shown in fig 2, is made up of C1, S1, R1 reset circuit, Y1, C2 and C3, crystals circuit. The control minimum system combining sensor module completes the obstruction detection.



The leg design

In order to ensure the leg mechanism controlled degree of freedom, better flexibility, requires each controllable degree of freedom is equipped with a set of transmission mechanism and a drive motor, but multiple control degrees of freedom need to add more sets of transmission mechanism and multiple drive motor, the body weight increase much, the control is more complicated. So, on the premise of ensuring normal movement, the leg mechanism of degrees of freedom, the less the better.

Design the structure of legs as shown in fig 3. The structure of the legs is an open chain type joint, knee joint has a vertical shake degree of freedom. The hip has two degrees of freedom: vertical and lateral shake. The degrees of freedom are driven by the steering gear.

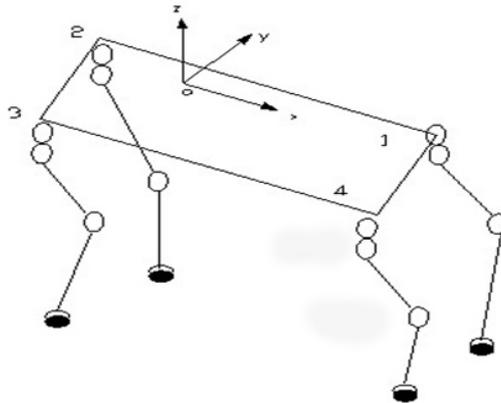


Fig 3 Robot leg structure

The walking posture and the dynamic balance of the transformation, the instability of the structures has a lot of challenges to study the control theory and the design of the real-time control system. This paper uses dynamic walking of Trotting gait, namely the two legs is exactly the same movement on the diagonal, all in the swing phase or in support phase. The abbreviation is referred to as diagonal gait [5, 6].

The system software design

The whole work process robot as shown in fig 4

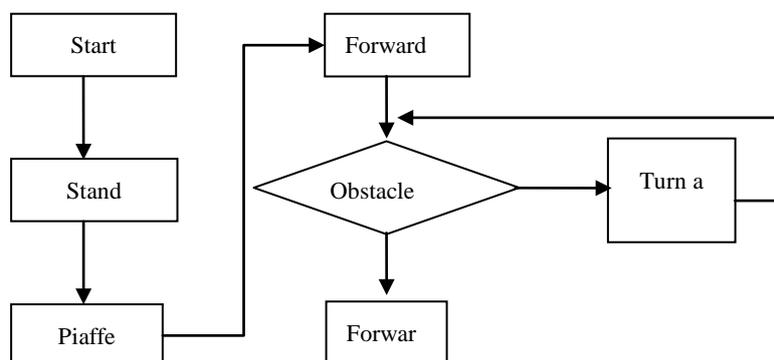


Fig 4 robots work route chart

When the robot start, the MCU controls the steering gear, makes the robot to stand. First piaffe twice, and then forward. The forward gait is trotting posture, two legs are supportive of diagonal foot alternating. In the process of advanced moment, the MCU timely checks the reflection of sensors' information type. If there are obstacles ahead, robot automatic turn, again after turning the monitor, if there are no obstacles ahead, back to the original track to move on.

Conclusions

In this paper, introduce a simple and easy walking quadruped loaded robot design at a constant speed of walking, simple structure, reliable performance and low cost. The four-legged weight-bearing walking robot based on bionics principle, using aluminum plate as the main body of robot material, single chip microcomputer as the core of the controller, steering gear as a driving element. Experiment proved that the robot can strictly in accordance with diagonal trot walking posture, which can realize larger load, has great market prospect.

On quadruped walking robot application fields there are still many problems unsolved, such as Variable walking speed, the speed in turn and the gait in movement of the leg mechanism and relationship, etc., it will be the next research object in this paper.

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