Robotic Snake

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Abstract— Research on snake-like robots expands the fields of application of robots.Based on control area network(CAN) bus technologies,we control the snake-like robots.They can use to search for survivals in shambles,of earthquake,fire.Its maximal distance of communication is 10 km,while calculating bit rates is up to 1 mbps.monitoring system which is connected to the control system through wireless communication.microcontrollers (MCU) are applied to our robort control system and snake-arm robot is a slender hyper-redudant manipulator.the high number of degrees of freedom allows the arm to “snake” along a path or around an obstacle. the master module consists of a 16-bit MCU,a wireless communication module and a sensor part.The snake robotics is used in various military uses,these are navigate very confined spaces used to search for people trapped in collapsed bulidings.

Key words: Robots,CAN bus technology,MCU

I. INTRODUCTION

Snakes exist all over the world. Snake-like robots are trying to take snakes’ locomotive and behavioral advantages for robotics. Conventional wheeled robots can travel smoothly and efficiently on plain surfaces, but not on rough terrains, where snake-like robots, without legs or rollers, can move stably and it is able to move like snakes. Modularized configuration makes snake-like robots reliable and easy to maintain.

It can carry small amount of food or water to peple trapped by the buildings to the arrival of recue personnel.The snake robot also be used for surveillance and maintenance of complex and possibly dangerous structures such as nuclear plants or pipelines.snake robot is designed by the one end fixed to a base which can reach hard to get the places.

The examples or some models of snake robots are multi-link snake robot, snake-like or snake robot, hyper-redundant robot and G-snake robot. These snake robot are implemented with passive wheels or without wheels.

II. CAN BUS

Control Area Network (CAN) bus, originally developed in 1983 by a German Company, Bosch, for automobile-manufacturing industry, is a kind of serial communication network which can effectively support distributed and real time control. Its maximal distance of communication is 10 km, while its bit rates is up to 1 Mbps. Diverse communication materials, such as twisted pair wires, coaxial cables, and optical fibers,can be applied to CAN bus.

III. DESIGN

A snake is a vertebrate. Its vertebral column consists of approximate 300 – 400 bones. skeletal mechanism of a snake’s movement is very complicated. The spatial movement model of our snake-like robot, which consists of many similar modules, is displayed In this model, a joint has two independent degrees of freedom, tilting up and down around the pitch axis which is parallel to the ground and perpendicular to the body, and turning left and right around the yaw axis which is perpendicular both to the ground and the body direction. The movement of our snake-like robot is realize by controlling the relative angle between each two conjoint joints.

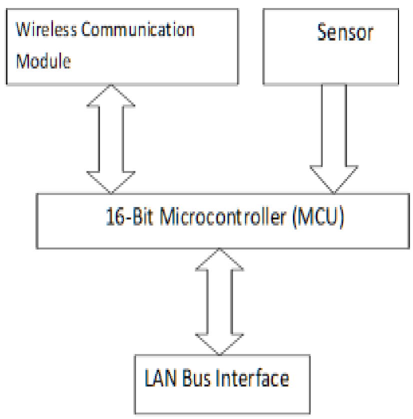
IV. STRUCTURE OF THE CONTROL SYSTEM

Based on the characteristics of our snake-like robot, we applied CAN bus technology to develop the snake-like robot’s control system. At the top of the control system, there is a monitoring system which is connected to the control system through wireless communication and can send control commands, such as serpentine, side-sliding, rolling, moving forward and moving backward, to change the moving status of the robot. All the executive modules of our control system are connected by CAN bus, which gives our system great expandability.

Microcontrollers (MCU) are applied to our robot control system. From a hardware technology for each executive module has a MCU which can independently control the movement of a joint, thus enabling the distributed control of our snake. A snake-like robot has many nodes, and distributed control can greatly improve the stability and real-time ability of the system.

V. STRUCTURE OF MASTER MODULE

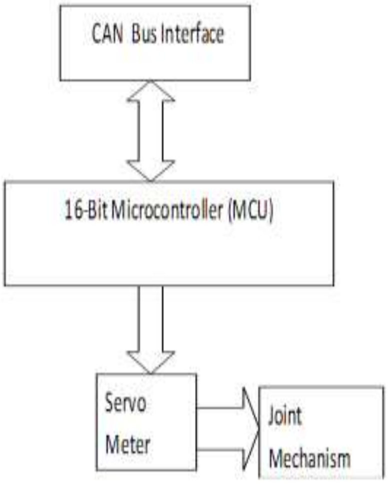
The master module consists of a 16-bit MCU, a wireless communication module and a sensor part. It can communicate withothermodules through the CAN bus interface (82C250).



Working principles: Monitoring system sends out control commands. Wireless communication module receives the commands, then sends them to MCU throughthe serial port 1 of MCU. Based on the control commands the MCU receives, the MCU will decide the destination, the movement direction, and the locomotive mode to employ. The sensor is used for gathering detailed information of the ground, according to which MCU will program the movement and control each executive module to accomplish the movement by communicating with each module through the CAN bus.

VI. STRUCTURE OF THE EXECUTIVE MODULE

The hardware structure of each executive module is the same. The MCU of an executive module can communicate with the master module through the CAN bus, and receive control commands from the master module. After computing, it will generate Pulse-Width Modulation (PWM) signals to control the movement of each joint.



For the following two reasons we chose PWM signals to control the movements of motors: first, the corresponding servo motors are small; thus, each joint of our snake-like robot can be made relatively small. Second, PWM signals are stable and easy to control. Just a proper pulse width can make the motor move to a certain position.Using PWM signals can improve the stability and anti-jamming ability of our snake-like robot and make our robot more stable even under rough circumstances.

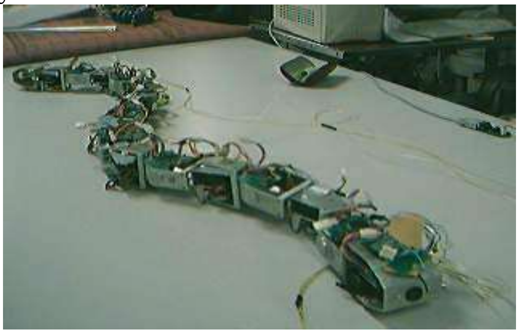
VII. DISTRIBUTED CONTROL MODE

In distributed control mode, the master module is needed to send out variable s to each executive module at the same time and synchronize the movement of each executive module instead of computing all the angles.

Then each executive module computes the angle it should pose, and sends back a computing-finished signal to the master module.

VIII. TEST RESULTS

Based on the design plan of the control system, through a series of arrangements and debugging, we developed a sample type of snake-like robot which is 1.5 m long and weighs 2.2 kg. It has 16 modules, 8 joints; two modules form a joint. It can conduct 3 dimensional movements. On a hard surface, the velocity of our robot can be up to 0.1 m/s. The serpentine movement of our snake-like robot is displayed.



Serpentine of our snake-like robot

IX. MECHANISM

- Serpentine: snakes swing approximately in a sine curve, using the friction between their bodies and the ground to generate propulsion
- Concertina motion: some parts of the body move forward while other parts stay still as pivots
- Rectilinear locomotion: the skin moves relative to the skeleton while the muscles, which is connected to the skin and ribs, provides propulsion
- Side-winding: starting from the head, each part of the body alternately lifts up from the ground, using the friction.

X. ANOTHER TYPES OF ROBOTS:

A. Snakebot:

A snakebot is a biomorphic hyper redundant robot that resembles a snake. Many snake robots are behaviours, such as climbing stairs or tree trunks. But many robots are constructed by chaining together a number of independent links.this makes to failure,because they can continue to operate even if parts of their body are destroyed.

B. Arm:

"It works like the octopus Arm".

Several different approaches have been used to develop robots that have the ability to climb vertical surfaces.A snake robot is a continuously manipulator,much like the arm of an octopus.

An snake arm robort is a good design and structure of a robort.This has generally associated with whole arm manipulation.where the entire arm is used to grasp and manipulate objects,in the same way that an sanke moving to the road.

A snake arm robot is not a snakebot which mimics the biomorphic motion of a snake in order to slither along the ground.

C. Swimming:

It is calculated that when swimming some fish can achieve a propulsive efficiency greater than 90%. Furthermore, they can accelerate and maneuver far better than any man-made boat or submarine, and produce less noise and water disturbance. Therefore, many researchers studying underwater robots would like to copy this type of locomotion.

Advantages of snake locomotion

- Easy to move through thin holes and gaps
- Able to climb up and over obstacles
- Versatile and can act as both locomotors and manipulators
- Stable gaits for locomotion

XI. CONCLUSION

Snake-like robots can achieve stable movement and adapt themselves to many terrains.It is hoped that this document will help promote further research on the some important topics of snake robots of the overview given on modeling and designing. They are highly reliable and maintainable. The excellent real-time ability, reliability and expandability of the CAN bus, combined with its multicast working mode, support distributed control of our snake-like robot from a hardware technology. It can also made very robust to dirt and dust by covering the robot completely with a shell.

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