Report

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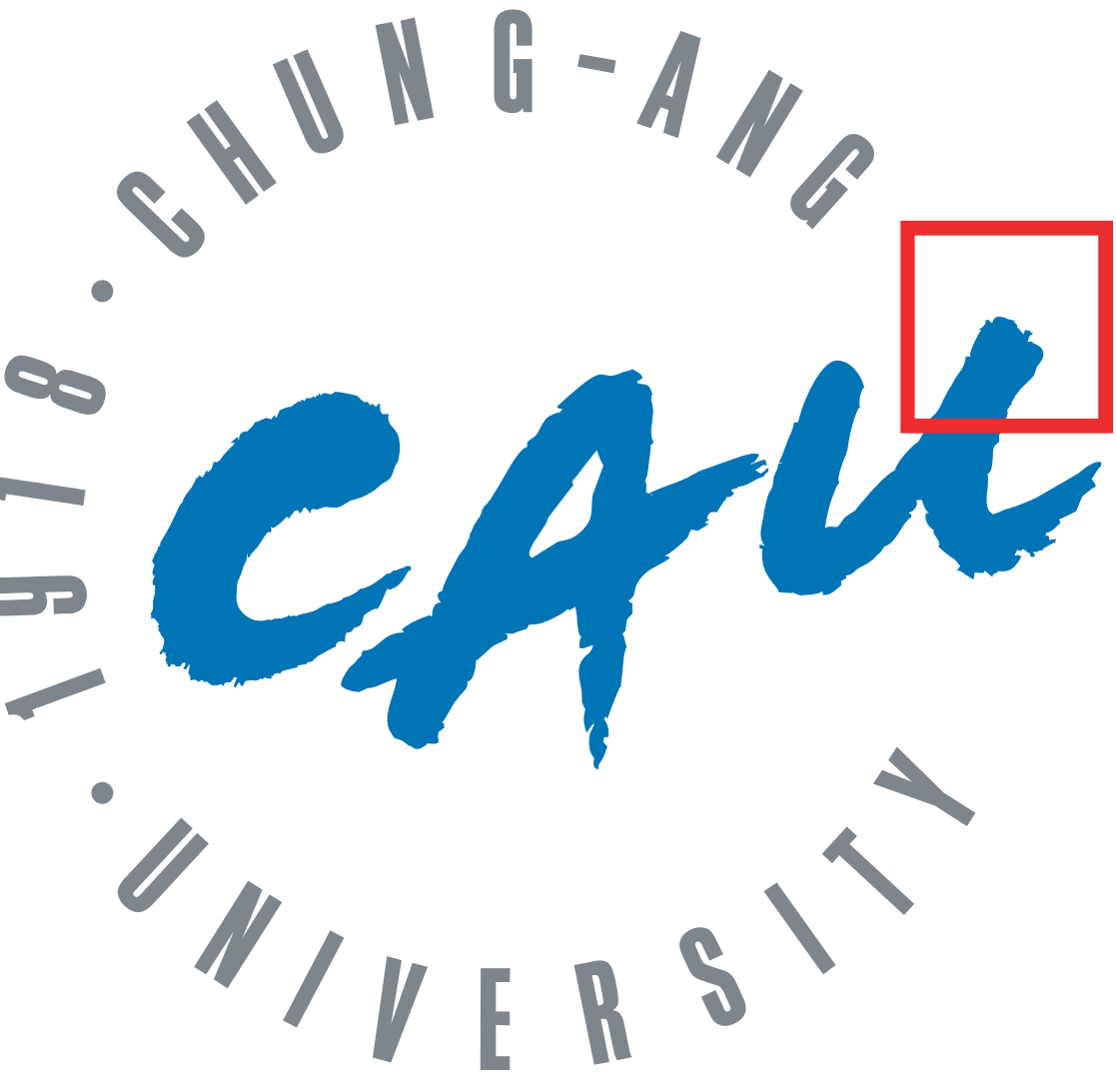


Abstract

The robot is one of the hottest topics. Long times ago, the robot only can do a small task, such as writing or activity mimic. However, a revolution of computing power, a robot can get a brain which is a computer. This makes robot communicate each other, This report introduces several applications of network protocol of robot.

History of Robot

Robot 'is a term commonly used by Czechoslovakian dramatist Carel Čapek, written in the 1920 play "R.U. R". In Czech, "robota" means "labor".

In the days when there was no word of robot long ago, I could see robots and similar things from many literary works. In Greek mythology, for example, there is a bronze giant called Talos. It is not called a robot in that it is a creature that is newly created and moves by itself, but it is enough to call this existence as a robot.

Over time, automated toy-level robots appear, often called Automata. From the 18th century on, various Automata were produced in Europe. This automatic machine can do simple operations such as writing poetry or drawing. The Flute Player, created by French engineer Jacques de Vaucanson in 1737, is a typical example. The first automata in Korea were made in 1438, and it can be said that it is a craft.

In modern times, robots are used in various fields, and there are various kinds of robots accordingly.

In the ground, the robot begins to get a dynamics action. Now a robot can run or move fast using a wheel. Also, by a revolution of computing power, robot get a brain which means it can do intelligent actions. This brings robot communications and cooperation work.

In the sky, we can find an Unmanned Aerial Vehicle which is known as UAV or drone. Many aerial vehicles are controlled by people, but it is very tiring to manage it constantly. So, by an unmanned system, we can control on the ground, and don’t need to check the status of vehicle periodically.

In the ocean, there are too many dangerous areas, so it is still known as a mysterious place. To clarify these unknown things, many scientists try to make new types of exploration robot. After having this communication system, a robot was free to go to various places, and people were waved from human injury.

Mobile Robot Network protocol

A mobile robot is an automatic system that is capable of locomotion. Mobil robots have the capability to move around in their environment and are not fixed to one physical location. Mobile robot may have wheels, tracks, legs or a combination of them.

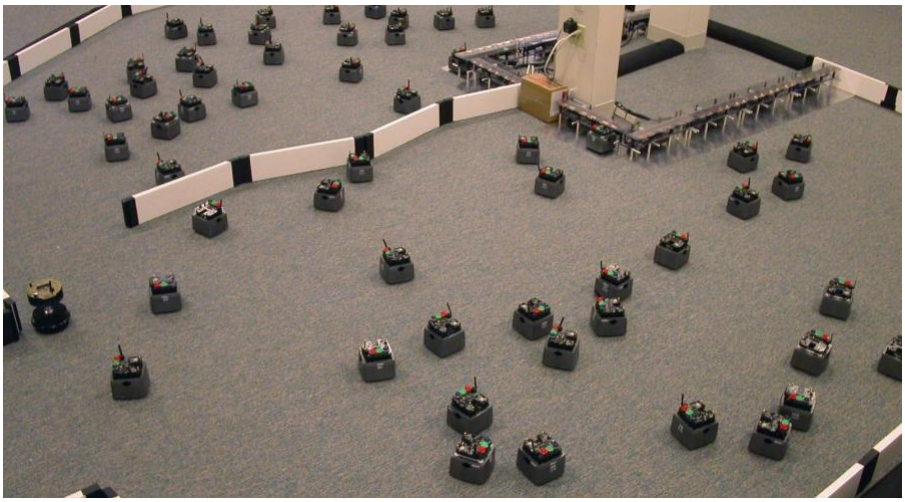
A mobile robot system might employ communications one of the following modes.
- Between a robot and a user "control display" station
  To send command tasking from the user to the robot and to receive back from the robot system status and environmental data
- Between robots in a multi-robot system
  To support local sensor data fusion, to provide cueing from one sensor to another
- Between the robotic system and external clients
  supporting the transfer of sensor data or other processed information from the robot system to superior military commanders.
- Between robots and the robotic system developer
  To reduce technical risk and increase implementation productivity

COTS wireless Ethernet transceiver and bridge technologies such as the Arlan devices adopted by the MDARS project provide a number of features which are very attractive for mobile robot systems, including self-organizing networking, data packet auto-routing, mobile roaming/handoff, and remote SNMP configuration control.

One of these which is relevant to the requirements of the mobile robot application is Reliable Data Protocol (RDP). It is developed by BBN for DARPA in the middle 1980s, RDP is a Transport layer protocol. RDP is an "Experimental Protocol" whose implementation status is "Limited Use". RDP was specified in RFC 908, dated July 1984, supplemented (rather than replaced) by RFC 1151 dated April 1990.

The MSSMP Transport layer protocol is the definition, design, and implementation of the RDP protocol. as an example of a reliable message-based Transport service including a system for buffering the messages to be transmitted, message-oriented (as opposed to TCP's byte-oriented) sequence numbers, retransmission timeouts, and selective acknowledgements.

Multi-Robot System Network Protocols



Multi-Robot System (MRS) is a system consisted of multiple robots which can cooperate and communicate with each other. It has been observed in many instances that multiple robots cooperate to perform complex tasks that would otherwise be impossible for one single powerful robot to accomplish. [i]

In MRS, there are two types of system.[ii] The first is “Collective swarm systems”, second one is “Intentionally Cooperative Systems”. Collective swarm systems require minimal communication with other robots, intentionally cooperative systems use two things which is strongly cooperative weakly cooperative.

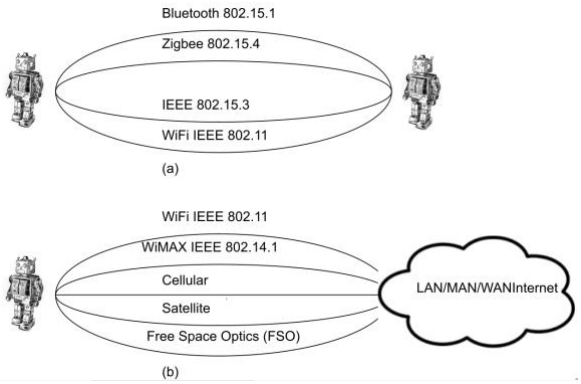
Two types of communication links can identify for MRS systems to be able to accomplish their various tasks and services: Robot-to-Robot (R2R) and Robot-to-Infrastructure (R2I).

Since robots are mobile during a significant portion of their operational time, they constitute a specific type of mobile ad hoc networks (MANETs). Certain protocols that are appropriate for MANETs can be used at the various layers of the open system architecture (OSI) model. These layers include the physical, data link, network, transport, and application layers (The session and presentation layers are commonly merged with the application layer).

At the physical and data link layers, MRS communication can use the IEE 802.11 (Wi-Fi) protocol. Since the network layer is responsible for end-to-end routing from the source node to the destination. So, there are many possible options such as “Static routing”, “Proactive routing”, etc.

Robot-to-Infrastructure (R2I) communication

MRS networks very often need to exchange information with infrastructure networks or the Internet. In this case, one of the robots that are connected to the others through R2R links can be equipped with additional resources, which enable it to play the role of a gateway node provide connectivity with the backbone network and the Internet. In the R2R and R2I communication, the carious networking protocols can be selected by the network designers. [iii][iv][v]



Underwater Robot Network Protocols

These kinds of robot work under the ocean. Main purpose is exploration, which is find new species of living things or new material such as gas or mineral.

Ocean is quite hostile environment, so it is very hard to communicate using line. In this review, we will focus on the wireless communication. This tech brings several applications such as oceanographic data collection, scientific ocean sampling, pollution and environmental monitoring.

In this network, robot will play the role of mobile nodes in future ocean observation net- works by virtue of their flexibility and reconfigurability. Many researchers have been engaged in developing networking solutions for terrestrial wireless ad hoc and sensor networks.[vi]

Medium Access Control (MAC) Protocols

Current underwater MAC solutions are mainly focused on carrier-sense multiple access (CSMA) or code-division multiple access (CDMA). CDMA is a promising *physical* and *MAC layer* technique in this environment because it is robust to frequency-selective fading.

Routing Protocols

Routing protocols can be divided into three categories, namely, proactive, reactive, and geographical.

- Proactive Protocols:
- Reactive Protocols: It is more appropriate for dynamic environments.

- Geographical Protocols: It is very promising for their scalability feature and limited signaling requirements

Transport-Layer Protocols
Segmented Data Reliable Transport (SDRT) is one of the transport layer protocols implementations. The SDRT is use Tornado code to recover error packets to reduce retransmissions. The data packets are transmitted block-by- block, and each block is forwarded hop-by-hop.
(Tornado code: it is a class of erasure codes that support error correction)

UAV (Drone) Network Protocols

Unnamed Aerial Vehicle which is known as drone or UAV refers to a pilotless (no human crew on board) aircraft. These are controlled by human or work autonomous. [vii]

The transmission medium for UAVs is radio frequency and microwave spectrum. A UAV needs an operator control on the ground, and a network of UAVs uses a protocol for communication. So many researchers work to design communication protocols to operate UAV completely autonomous and cooperate with each other. [viii] UAVs usually use ISM 2.4 GHz band to transmit information to other aircraft or the base station (BS).

The characteristic of a network of UAVs is very similar to a MANET (Mobil Ad-Hoc Networks). Because FANET (Flying Ad-Hoc Network) is a special class of MANET. [ix] By apply network on the UAV, it has been used in various applications such as surveillance and monitoring, most of the networking protocols have been developed for military use. There is a premise of a big assumption which is all architectures treat BS is the ground node. [x]

There are two main architectures, first is centralized architecture second is decentralized Ad-Hoc architecture. So multigroup UAV network is a combination of Ad-Hoc and centralized communication. Based on this architecture, researcher builds 5 types of protocols.

1. MANETs Protocols
   Since FANETs is a subclass of MANETs, most of the routing protocols used for MANETs can be used in UAV networks. [xi]
2. Location and geographical-based Protocols
   The communication scheme has one UAV and some nodes on the ground. In each time slot (5 seconds), the UAV has to decide if it transmits data and with whom it communicates. [xii]
3. Mac Layer Protocols
   Directional antennas are used at the top and bottom of the aircraft. The UAV senses the medium

to determine if there is any ongoing communication. If the medium is empty, then the UAV can transmit data. [xiii]

4. Shortest-path based Protocols
   Similar to MANETs, UAV networks need to have a reliable communication among the nodes.so transmit the information in a channel with low BER and high SNR. The source node starts by sending a route request to the neighbors. When a node receives the message, they rebroadcast and calculate a cost based on the inverse of Shanon's capacity.
5. On-Demand Protocols
   This method is called as Ad-Hoc UAV Ground Network. The Ad-Hoc network performance depends on many factors such as the quality of the channel. Use Dynamic Source Routing (DSR) protocol for communication with other nodes.

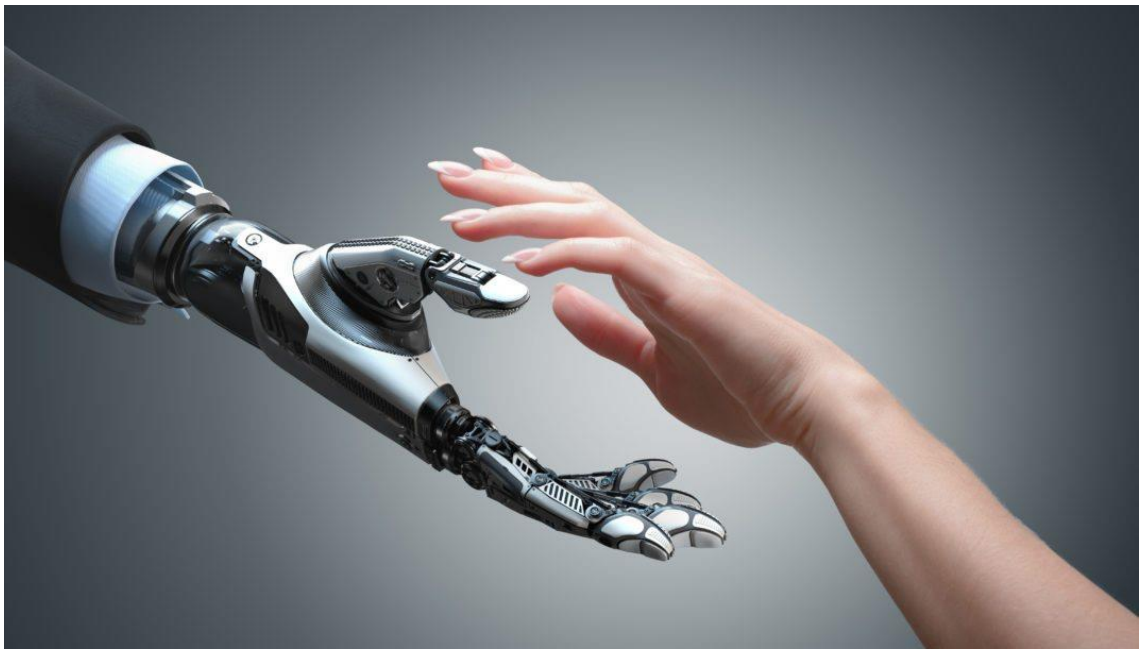
Conclusion

I reviewed many types of robots in terms of network protocols.

After this review, I recognize that network protocols are basically affected the environment, namely, characteristic of a node is most important. If the node is defined, then a base feature of the network is figured out.

I choose a robot as a network node. This made the network more dynamic and required stability. So in our paper, Ad-hoc network protocols are mainly revealed.

So, based on this work, If I build a network, I will think about the characteristics of the node.



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