

Research of Intelligent Home Robot based on Home Network

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Abstract: This paper present the control of an intelligent home robot based on home network. The existing research is almost research of independent robot. home network will be a way that equipments in home exchange information. As robot combine home network, robot will be more intelligent and more powerful. We benefit for that load is divided in home network environment. The robot which has ultrasonic sensors performs obstacle avoidance with the Fuzzy Algorithm. Ethernet serial converter transmit the measuring data of home to a home server and the home server accumulates data. The home server controls the robot and manages home according to the acquired data. This paper supposed the home network system that consist of home server, embedded robot and intelligent home robot.

Keywords: robot, fuzzy, home network, intelligent

1. INTRODUCTION

Network is spreading to family fast and there is utilization ratio of internet in increase trend continuously. Network is acting role of passageway that transmit various information, and is forecasted that these network and robot are combined forward. Most robot until now was form that act separately. However, can exchange necessary information to robot through network that is established already in environment of home network and embody various function. Also, robot exuviates in mode that handle all works, can gain advantage that is distribution of work that use network. Reduce work load of robot by way to separate separately do home server, sensing module instead of center work such as data save, environment perception to robot itself and connect to network. These tendency can find in several places, can find in a car that we touch always. Is satisfying and achieve distributed control and offer easy of extension that connect ECU that is sensor and electronic control device to sense various state of a car by field bus such as CAN (Controller Area Network). In hereafter, is expected to develop in form of intelligent space (Smart Space) that robot acts home network of various way to base. Research that see in this side can assume that have effect of virtue research for intelligent space.

Intelligent robot manages and operate electronic product of home server, home's TV through gear with embedded system, audio and so on of home network and air conditioner, curtain etc.. configurationally from intelligent space. Also, act as deacon in home which report home state and work achievement result present to resident.

Supersonic waves sensor for infrared rays for short distance, sensor great distance is used mainly at sensor of home robot. Form that move using several kind of sensors with method that use supersonic waves becomes many [1,2,3]. Whole system that embody in this research is divided by vehicle robot, home server, embedded system. Home robot embodied collision escaping that presume position, and apply fuzzy algorism using supersonic waves sensor and rate gyro sensor [4,5,6]. embedded system acts role that measure home temperature, illumination data and transfer to home server. Home server gives job order to robot according to appointed schedule and user's establishment value, present from outside home state environment that can do monitor.

There is intelligent home robot, home server and network, Embedded Robot greatly in hardware structure to embody intelligent home robot system of home network base, control various household electric appliance. It can say as purpose of intelligent home robot system to chain these organically and a person lives that make environment that is convenient. Whole system and composition appeared to fig. 1.



Fig1. Whole schematic diagram of system.

2. SYSTEM ORGANIZATION

2.1 Compositon of home robot

2.1.1 Hardware

Hardware drive department made use of DC motor, and compose 2 wheels basically. In the case of remainder assistance wheel, used 2 ball caster way. Displayed external form of robot to fig. 1. Lower part base frame used 10T's aluminum, and body frame improved extensivity and easy installation party using aluminum profile. Outside body used 10T relationship acryl for party reason of processing late. Expressed drive department and position of sensor to fig. 2. Main board used Pentium 1.2GHz CPU, and sensor used polaroid 6500 for distance more than 30cm, and 7 are

established whole surface and side all. Infrared rays sensor feels body of short distance and 8 are established on front, back, left, right ago all [8]. Used PIC micro controller for sensor signal processing and used serial communication for communication with main board. Power department separated main Board and circuit power with motor department used Ni-Cd battery. Main board and circuit power used DC-DC power supply. Equiped device that alarm when denote temperature of motor, motor drive, battery etc. by additional device and exceeded establishment temperature and appeared to fig. 4. Used LCD of touch screen way for user interface, and network appropriated 11Mbps radio LAN of IEEE802.11b standard. Robot through AP and home server, remote control communicates.



fig. 2 Intelligent home robot

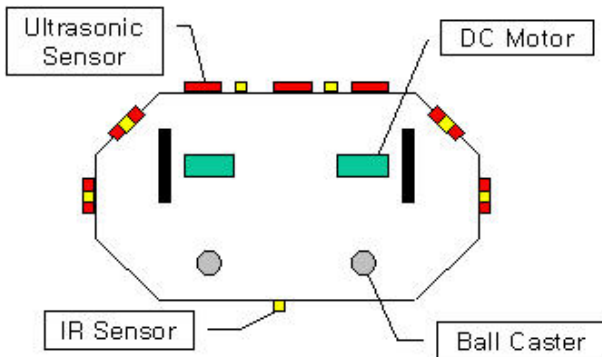


fig. 3 Drive department and sensor schematic diagram



fig. 4 Temperature sensor module

2.1.2 Mechanical Model

Drive wheel can made use of two motors and run transfer robot as that control their relative velocity [7]. Transfer robot comes two position variable x, y and need direction variable θ if mark position and direction because move in $x-y$ plane. Because use each Incremental encoder in two drive round, transfer robot do distant ages addition of direction standard coordinate system without can follow from standard coordinate system to companion coordinate to body coordinate system control. Use dead reckoning that presume carriage and the speed of transfer robot using information of encoder. The line velocity and rotation velocity of transfer robot are same with way Eq. (1),

$$v = \frac{\Delta_R + \Delta_L}{2\delta}, \omega = \frac{\Delta_\theta}{2\delta} \tag{1}$$

It is mileage of each round that alter during Δ_R course Δ_L silver sampling cycle here and during Δ_θ sampling cycle (δ) that increase of it direction change of transfer robot be. Each vector ingredient of vehicle's position is as following.

$$\theta = \theta_{old} + \Delta_\theta \tag{2}$$

$$x = x_{old} + \frac{(\Delta_R + \Delta_L)}{2} \cos(\theta_{old} + \frac{\Delta_\theta}{2}) \tag{3}$$

$$y = y_{old} + \frac{(\Delta_R + \Delta_L)}{2} \sin(\theta_{old} + \frac{\Delta_\theta}{2}) \tag{4}$$

$(x_{old}, y_{old}, \theta_{old})$ is position of previous transfer robot during δ time here.

2.2 Embedded Robot

State information of temperature in home, humidity, illumination etc. becomes important value in operation of robot and appliances. Composed Embedded Robot by method to get these information in this research. Measure that each sensor is not concentration that is linked to main controller establishes in necessary place, have distributed structure that transmit data through network. This distributed structure is used abuzz in present field. Data that is transmitted through network to home server save is managed and this is used in operation of robot and electronic appliance. As is different in each space established temperature, humidity monitor and control. Embedded Robot developed in module form, Micro-controller and sensor, Ethernet - serial converter is composed. User does establishment possibility measure cycle, and sensor department's signal is amplified and is processed in Micro-controller through AD Converter. Data that is processed in Micro-controller is transmitted to network through Serial-Ethernet Converter of fig. 5. This module could be applied, and displayed application of JAVA base that receive data through network from do fig. 7 monitor chapter running remote supervisory control individually. Gave private IP to each mounting in this research, have structure that Embedded Robot course home server through wireless LAN base, home robot is linked.



fig. 5 Ethernet serial converter



fig. 6 Embedded robot

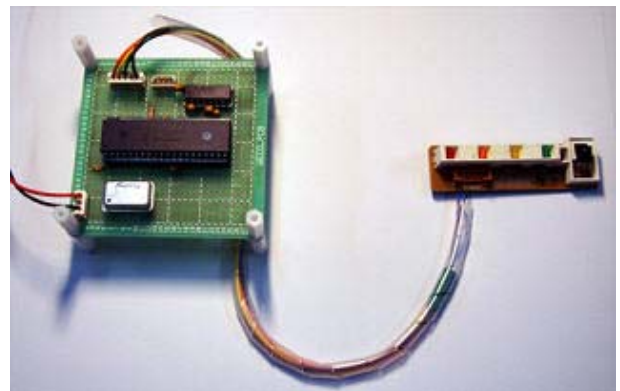


fig. 8 Model air conditioner reception module

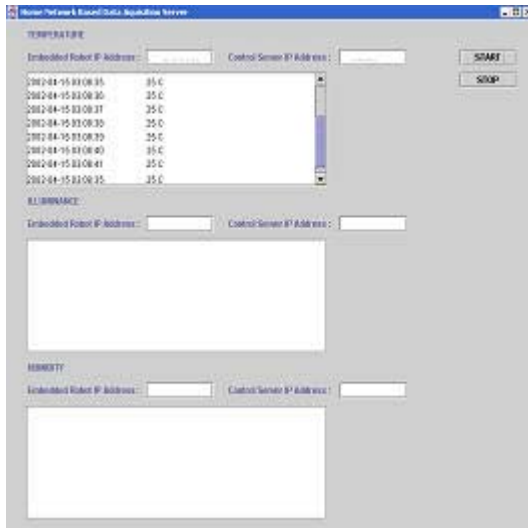


fig. 7 Data reception program

2.3 Model air conditioner

Data that is collected from Embedded Robot to home server save and manage. This data though home robot controls electronic appliance to base this research model air conditioner compose and experimented. Consisted model air conditioner is by structure that control by control group that have remote control interface such as general air conditioner,

and is threaded to robot. Interface composed, and displayed picture of composition department fig. 8 and fig. 9 through micro controller and remote control signal data sheet. Interface department runs serial communication, and associate with Ethernet converter and data can do send-recvie. Embodied temperature control of air conditioner and control of power through home robot according to home server's command in this research, and achieved an experiment with scenario of all interceptions through breakdown. Consisted model air conditioner transmits packet to home server through network periodically, and home server can foretell action existence and nonexistence of air conditioner through this. That is, can assume as way similar to that foretell availability of down that transmit periodic packet to host on network. If packet are not transmitted for schedule time, judge and shut off power and keep away decline of temperature by strangeness of air conditioner. Such function electronic appliance periodic state data to home server transmit, and home server can be applied in breakdown detection using loaded breakdown diagnosis algorithm.



fig. 9 Model air conditioner

2.4 Home server

Home Server's composition home server running model air conditioner, Embedded Robot, communication with home robot, take charge collection and management of data. Saving each data that collect from Embedded Robot DB, manage by time. This is composed can do search through exclusive use application, and possible to monitor through web. Can know home temperature through general web browser, illumination, state of humidity as is obvious. Displaying monitoring screen through web to fig. 10.

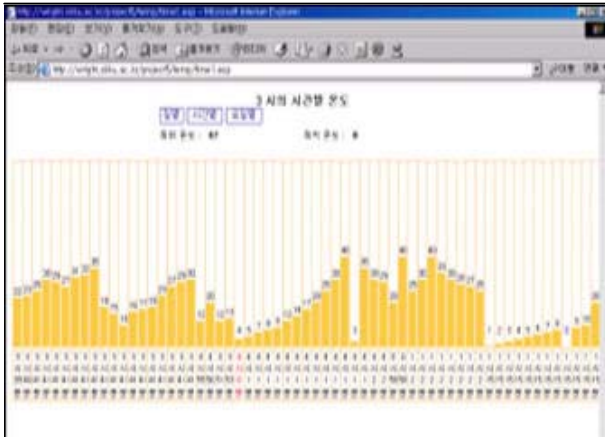


fig. 10 Monitoring through web

2.5 software compositions

Composition of software is consisted of home server software and software that is loaded to intelligent home robot. Home server application made out by Visual Basic, DB server is MS SQL2000, WEB server is consisted to operate based on Ethernet environment using MS IIS 4.0. Their role handles and analyze because procure data that get in Embedded Robot to server and apply purge algorism and informs strangeness when something wrong data enters. Software that is loaded to intelligent home robot used fuzzy algorism for collision escaping and moving. Received distance with obstacle and the present speed by input variable and output used direction and speed. Distance with obstacle gets through supersonic waves and infrared rays sensor, and direction and speed control through each left, speed control of right motor. Used purge control of Look-up table base for increase of advantage and the processing speed on calculation, and expressed distance and quantization about the speed table. 1 and table. 2. Displayed rule base in table. 3.

Quantization	Range
0	$E < 0$
1	$0 \leq E < 10$
2	$10 \leq E < 20$
3	$20 \leq E < 30$
4	$30 \leq E < 40$
5	$40 \leq E < 60$
6	$60 \leq E < 80$
7	$80 \leq E < 100$
8	$100 \leq E < 120$
9	$120 \leq E < 140$
10	$140 \leq E < 160$
11	$160 \leq E < 180$
12	$180 \leq E$

Table1. 1 Quantization of distance

Quantization	Range
0	$E < 0$
1	$0 \leq E < 1$
2	$1 \leq E < 2$
3	$2 \leq E < 3$
4	$3 \leq E < 4$
5	$4 \leq E < 6$
6	$6 \leq E < 8$
7	$8 \leq E < 10$
8	$10 \leq E < 12$
9	$12 \leq E < 14$
10	$14 \leq E < 16$
11	$16 \leq E < 18$
12	$18 \leq E$

Table. 2 Quantization of velocity

d \ v	PB	PM	PS	ZO	NS	NM	NB
PB	PB	PB	PB	PB	PM	PS	ZO
PM	PB	PB	PB	PM	PS	ZO	NS
PS	PB	PB	PM	PS	ZO	NS	NM
ZO	PB	PM	PS	ZO	NS	NM	NB
NS	PM	PS	ZO	NS	NM	NB	NB
NM	PS	ZO	NS	NM	NB	NB	NB
NB	ZO	NS	NM	NB	NB	NB	NB

Table. 3 Fuzzy rule base

3. EXPERIMENT AND CONCLUSION

Self-regulation traveling of robot that is used by fig. 11 this research thing which do simulation be. Robot avoids stumbling block and run appointed command after reaching in the destination. In this research network to base a home robot embody. With measure data that embodied scenario is stored to home server, enabling monitor from outside, achieve temperature control in air conditioner operation command frontage to robot. This research will embodied interface with single appliance, but embody intelligent home network base system that is in hereafter more through interface embodiment with various device.



fig. 11 Obstacle avoiding simulation

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