

Block Type Modular Robot: Mom's Friend

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Abstract:

Nowadays, people have various personalities and the things they want are also diverse. In the case of clothes, it is possible to produce multifariously. However it is impossible to produce variously for robot industry because the demand for robots is low and the price is high. It is needed to give the right of choice to people and the modular system can be the solution. One of the most important purposes of modulation is reusability of modules and functions. If each module has own functionality separately, people can select the modules which have the functionality they want. In this paper, we introduce a block type modular service robot system, "Mom's friend". People choose the function block modules which have different operating system, function, and shape and heap up the block modules, like playing with blocks, for assembling the robot. Mom's Friend can recognize which block module is assembled in real-time by a self-diagnosis system and then a main supervising system connects the new block module to the whole robot system. There is no need to set up or control by people. Each block module has a pair of connection socket array for communication with other block modules. Mom's Friend makes various types of robot and it is possible to assemble any block module. We implemented eight block modules for building block type reconfigurable intelligent modular robot. SLAM module is for movement of robot. It controls 2 motors and uses sonar sensors, IR scanners, and one compass sensor. It also has obstacle avoidance function and real time map builder. Power module is a module that includes batteries to supply electric power. It supplies both 12V and 24V using lead batteries. Main module manages the connections of all modules. It gets the status of modules using many kinds of communications (e.g. TCP/IP, USB and Serial). It sends action commands of robot to each module depending on received commands and status. Vision module recognizes faces, characters and objects. Each function is implemented using optimal algorithms, because image processing needs high performance for recognition. Face processor detects faces by Haar detection algorithm and recognizes faces by OfflinePCA and SVDD algorithm. We use SIFT algorithm to recognize objects. When the robot tries to grip an object, it recognizes what the object is, and calculates how far the object is. Home appliance control module operates various home appliances using Bluetooth communication. Manipulator module controls both arms and hands. It grips an object and uses instruments. It also expresses gestures to show robot emotions to users. Head module is for emotion expression and getting two camera images. As robot neck has Pan-Tilt system, face tracking is possible. It expresses about 20 types of emotions using eyes and a mouth. Mom's friend has internal emotion and it responses directly and indirectly to external stimulus. If it knows a user's face, it has like-dislike degree to user, and expresses an emotion. Speech module recognizes users' speech in two languages (Korean and English). It has STT(Speech To Text), TTS(Text To Speech) engines. STT engine finds almost similar word in speech map. We use HMM algorithm for speech recognition. As it recognizes users' speech, it transfers commands to main module through communication network. Main scheduler manages to communicate among each module by TCP/IP communication. Although operating systems are different from other modules, one module can communicate with other modules. For proper communication, we define mark up language and develop a parser to manage these. It needs thread synchronization among processes. We assembled various types of robot using these block modules and ascertained the superiority and efficiency of the introduced modular robot system.
