# Department of Electronic Control Engineering

## Digital Systems and Machine Learning

Tetsuya FUKUNAGA

Professor, Dr. Eng.

Email : fukunaga@gifu-nct.ac.jp

| Research Fields | FPGA, Reinforcement Learning, Sensors |
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## ● Research Outline

### Digital Systems using FPGA

Digital systems using FPGA are designed by VHDL. FPGA is a field programmable gate array, and it's very useful for research and development. VHDL is one of the hardware description languages. My laboratory has 9 computers for designing the digital circuits , and I used Quartus 2 software to design the digital circuits. My research fields are vision recognition system, plotter control system and robot control system. The vision recognition system has 2 cmos cameras and it recognizes three-dimensional positions of objects by stereo method. I developed an original circuit for the cameras. The plotter control system controls 2.5-axis plotter by FPGA. This system is also used for education. The robot control system uses the vision recognition system and controls a mobile robot. This robot has one web camera and two wheels and two hands. Photo 1 is our robot.
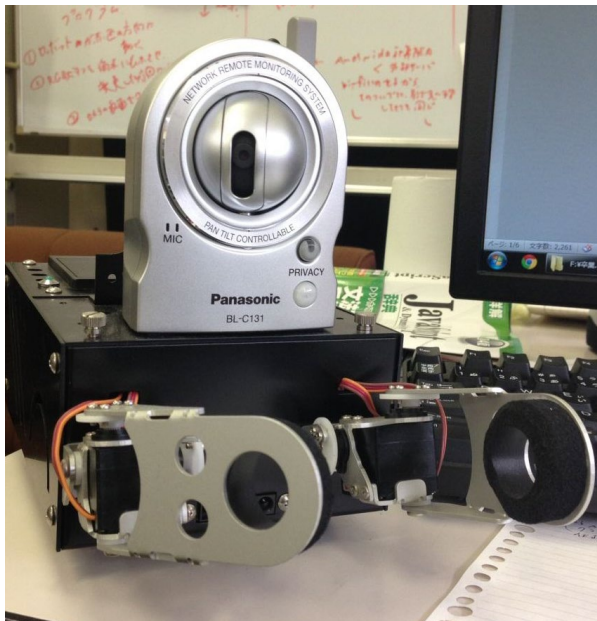
### Machine Learning

Reinforcement learning is one of the machine learning methods. This learning method is based on a learning system of creatures. Rewards and punishments are only information to control objects. Therefore, the learning system finds appropriate control method for it. Reinforcement learning is applied to robot control, economic prediction system, and so on. I had improved learning speed on reinforcement learning. My research was performed on a PC by computer simulation.

### Creation of a payload of a Pet bottle rocket

PET bottle rockets are well known as easy rocket systems. But human eyes can't know rocket's flight in detail because the rocket's flight is in a moment. Payloads are rocket's loads. In this research, I develop a payload with some sensors. Sensors included:

・ADXL345 3Axis Accelerometer

・HMC5883L 3Axis Magnetometer

・ITG-3200 3Axis Gyrometer

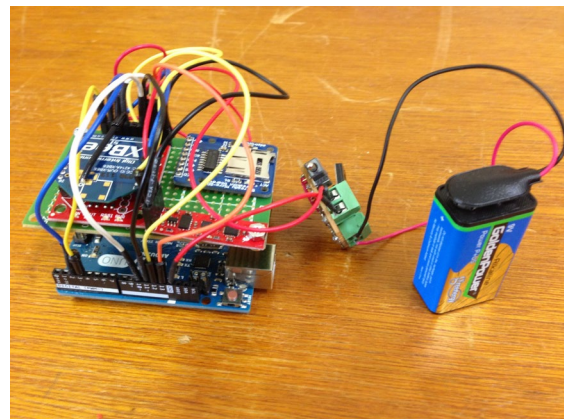From the results of experiments, detailed explanation during the entire flight of the Pet bottle rocket is caught.



Photo 1. mobile robot.



Photo 2. Payload.