Abstract—This project proposed “the internet of things architecture based fuzzy large scale system design.” Firstly, an internet of things system is modelled by a fuzzy large scale system with transmission latency and the packet dropout. Then, design the fuzzy feedback controller to stability the overall system. Based on Lyapunov stability theorem, obtain the Lyapunov-Krasovskii stability criterion. Finally, the proposed control strategy is applied to the two inverted pendulums coupled by a spring, and demonstrated the control performance.

Problem Formulation
Consider an internet of things system (IoT) as Figure 1. Since each elements of IoT are connected by internet, the common shared communication network, IoT exists the phenomenon of the transmission latency and the packet dropout and makes design IoT difficultly. So, this project would apply the fuzzy control and large scale system design to solve the problem of IoT design. The block diagram of the overall system is shown in Figure 2.

Controller Design
Based on the T-S fuzzy model (2), we design the T-S fuzzy feedback controller in which the rule of fuzzy is formulated in the following forms:

Control Rule:
IF \( q_i^p \) is \( A_i^p \), and..., and IF \( q_i^P \) is \( A_i^P \),

THEN \( u_{cp}(t) = K_{iP}^x_{cp}(t) \)

where \( u_{cp}(t) \) is the output of the controller, \( x_{cp}(t) \) is the input signal of the controller, \( K_{iP}^x \) is the control gain matrix.

Main Result
Consider the IoT system which can be modelled as the fuzzy large scale system in (1). Design the fuzzy controller as (2). The overall system is stable, if there exist \( K_i^x \) such that:

\[
\begin{bmatrix}
\Pi_{11} & \Pi_{12} \\
\Pi_{21} & \Pi_{22}
\end{bmatrix} > 0
\]

where

\[
\Pi_{11} = A_i^T \Sigma_1 Q_1 + Q_2 A_i^T + Q_3 + rA_i^T (3I + Q_3) A_i - \lambda^{-1}M_2
\]

\[
\Pi_{22} = (K_i^x A_i^T \Sigma_1 Q_1 A_i^T - Q_2 + rA_i^T + rQ_3 Q_3 A_i^T \Sigma_1 K_i^x A_i^T - \lambda^{-1}M_2
\]

Experiment Result
The two inverted pendulums coupled by a spring (TIPCS) is applied to demonstrate the control performance.

References
