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Intelligent Wireless Sensor Network

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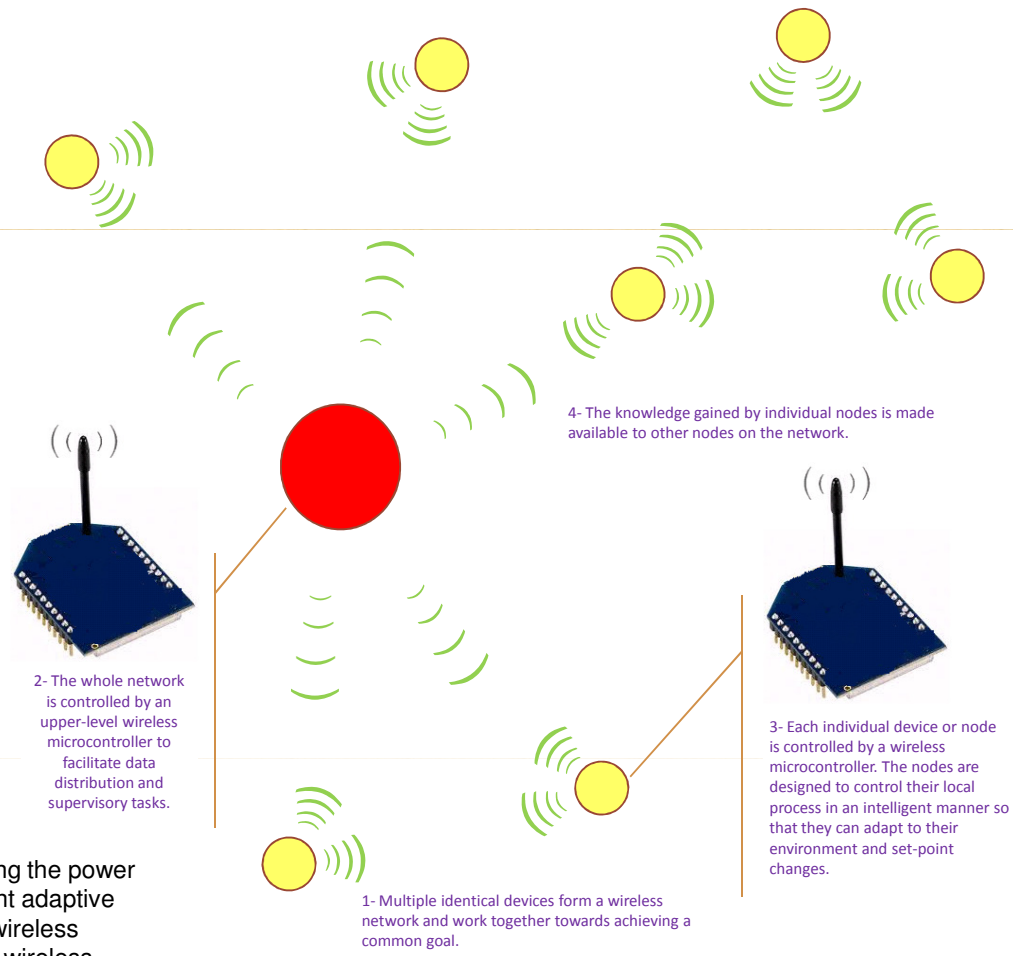
Introduction

Recently, there has been a significant increase in utilisation of embedded-microcontrollers in a wide range of applications, extending from commercial products to industrial process systems monitoring. Furthermore, improvements in speed, size and power consumption of microcontrollers with added wireless capabilities have provided new generation of applications. These include versatile and low cost solutions in wireless sensor network applications such as wireless monitoring system and control.
In many applications, there are situations where multiple identical devices form a wireless network and work together towards achieving a common goal. Individual device or node is controlled by a microcontroller, and the entire network is controlled by an upper-level microcontroller to facilitate data distribution and supervisory tasks. In order to maximise the network performance, the nodes are designed to control their local process in an intelligent manner so that they can adapt to their environment and set-point changes. The knowledge gained by individual nodes is then made available to other nodes on the network.

Aim and Motivation

The project is motivated by the concept of combining the power of embedded-microcontroller, ZigBee, and intelligent adaptive fuzzy controller. ZigBee as a low-cost, low-power, wireless mesh networking standard enables a new range of wireless control and monitoring; low power-usage, and highly reliable network applications. In addition, an adaptive fuzzy controller can make intelligent and automated system possible.
The aim of this research project is to implement fuzzy logic as an artificial intelligent control technique to devise a microcontroller-based self-learning algorithm that enables real-time adaptation.



Methodology

In order to improve fuzzy logic controller performance, different techniques are available for defining its parameters such as scaling the universe of discourse (known as scaling gains), tuning membership functions and rules. In this work, an adaptive fuzzy logic controller based on auto-tuning input scaling gains has been proposed. Design simulations have been carried out, and the latest results have been promising which indicate certain degree of improvement in system performance.

Advantages

- Further opportunities in designing new industrial and commercial applications such as wireless monitoring system and control.
- The cost of real-time control systems can be effectively reduced.
- An adaptive fuzzy controller can make intelligent and automated system possible.

Conclusions

- Complex systems require intelligent adaptive controllers to achieve and maintain high-level performance at different operating conditions.
- These controllers can be designed successfully by utilising fuzzy logic. This is because fuzzy logic control represents a systematic method to integrate human knowledge, and it is a non-linear control system.
- The simplicity of the algorithm is beneficial for embedded–microcontroller based applications. Computational time can be significantly reduced; as a result, consuming fewer resources such as processing power and memory and minimising the control loop time.

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