WIRELESS SENSOR NETWORK

BASED ON OPEN-SOURCE HARDWARE AND SOFTWARE

Tsonyo Vasilev

INTRODUCTION

Wireless sensor networks (WSNs) have attracted interest on a global scale in recent years, with market growth predicted to rise from $450 million in 2012 to $2 billion by 2022 (Rawat et al., 2014). Developing and deploying such networks, sometimes consisting of hundreds of nodes, has been enabled by rapid advancements made in micro-electro-mechanical systems (MEMS), which in turn allow for the creation of multi-functional sensor nodes that are inexpensive and have low power consumption (Akyildiz et al., 2002). While of key importance on their own, these advancements were integrated and refined into suitable hardware resources and highly efficient communications protocols in the late 1990s and early 2000s by the focused effort of researchers from all over the world (Krco, 2002).

PROJECT AIM

The aim of the project was to develop a network of remote battery-powered sensor nodes that take temperature and humidity readings from their environment that is then transferred to a master node via Bluetooth. The master node handles data processing and visualisation of said readings. Slave nodes were required to be autonomous for at least 12 hours and be build of off-the-shelf open-sorce hardware and software. Sensor data visualisation is perfomed on a host computer to which the master node is conected to.

METHODS

The Wireless Sensor Network developed as part of this project follows the star topology whereby a set of remote slave nodes communicate with a single master. Due to the relatively low number of remote nodes (3), and the required operational range of 10 metres , the star topology was selected as the quickest and most reliable arcitecture. Furthermore, hardware and power requirements for the slave nodes are kept to a minimum due to the fact that the it is the master node that deals with the most demanding tasks, such as initiating communication and performing data processing.

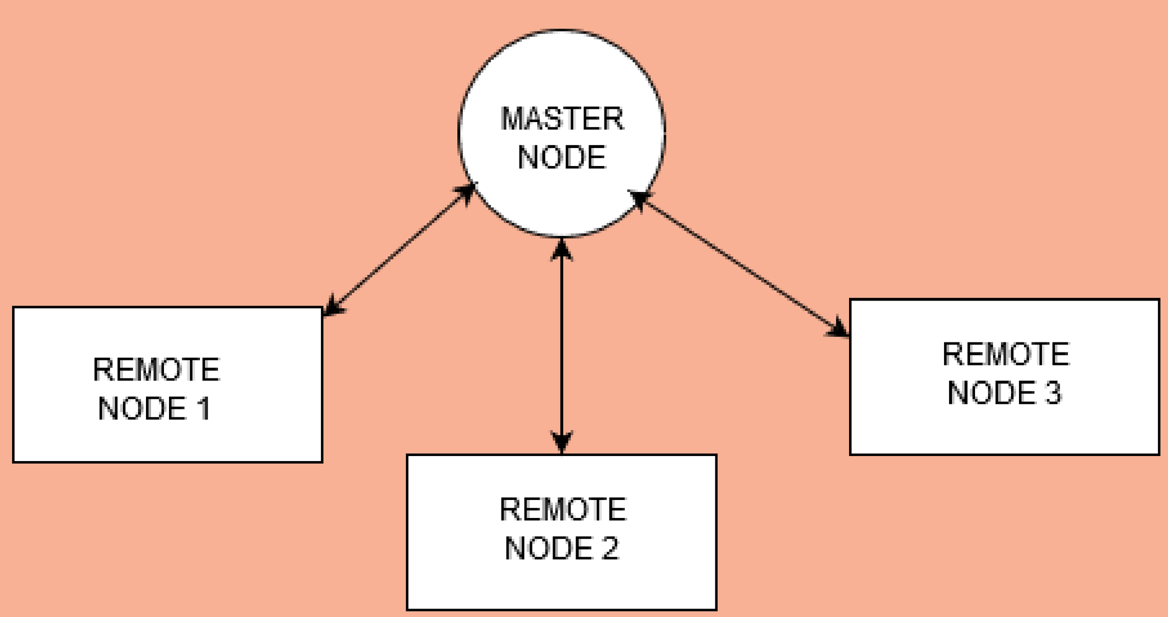

Figure 1: Star topology

HARDWARE

The Wireless Sensor Network (WSN) consists of two distinct parts in terms of hardware - a master node and a set of identical slave nodes. The master node, (*Figure* 2) of a microcontroller board based on the ATmega328P mcrocontroller and an HC-05 Bluetooth transceiver. Slave nodes (*Figure* 3), on the other hand, are comprised of the same microcontroller board but use a slave-only HC-06 module an a DHT11 temperature/humidity sensor . An overview of the hardware architecture of the slave nodes is shown on *Figure* 6 below (Ojha, Misra and Raghuwanshi, 2015). They are battery-powered and are power efficient enough to remain in operation for over 12 hours.

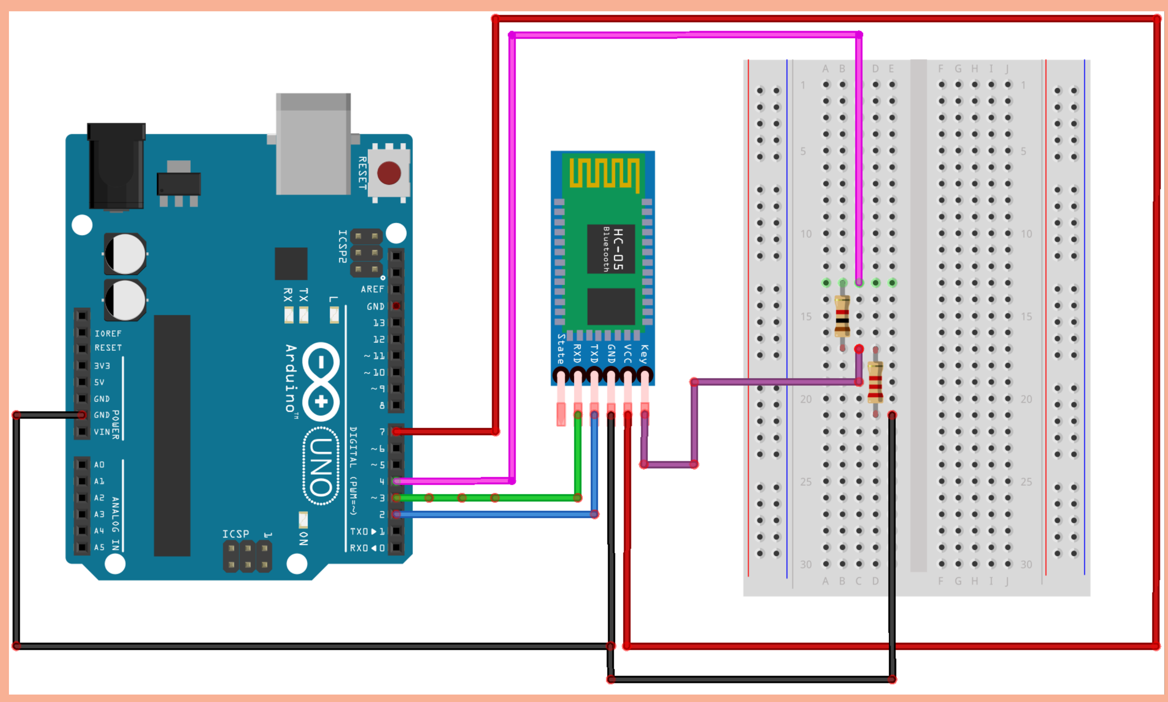

Figure 2: Master node diagram

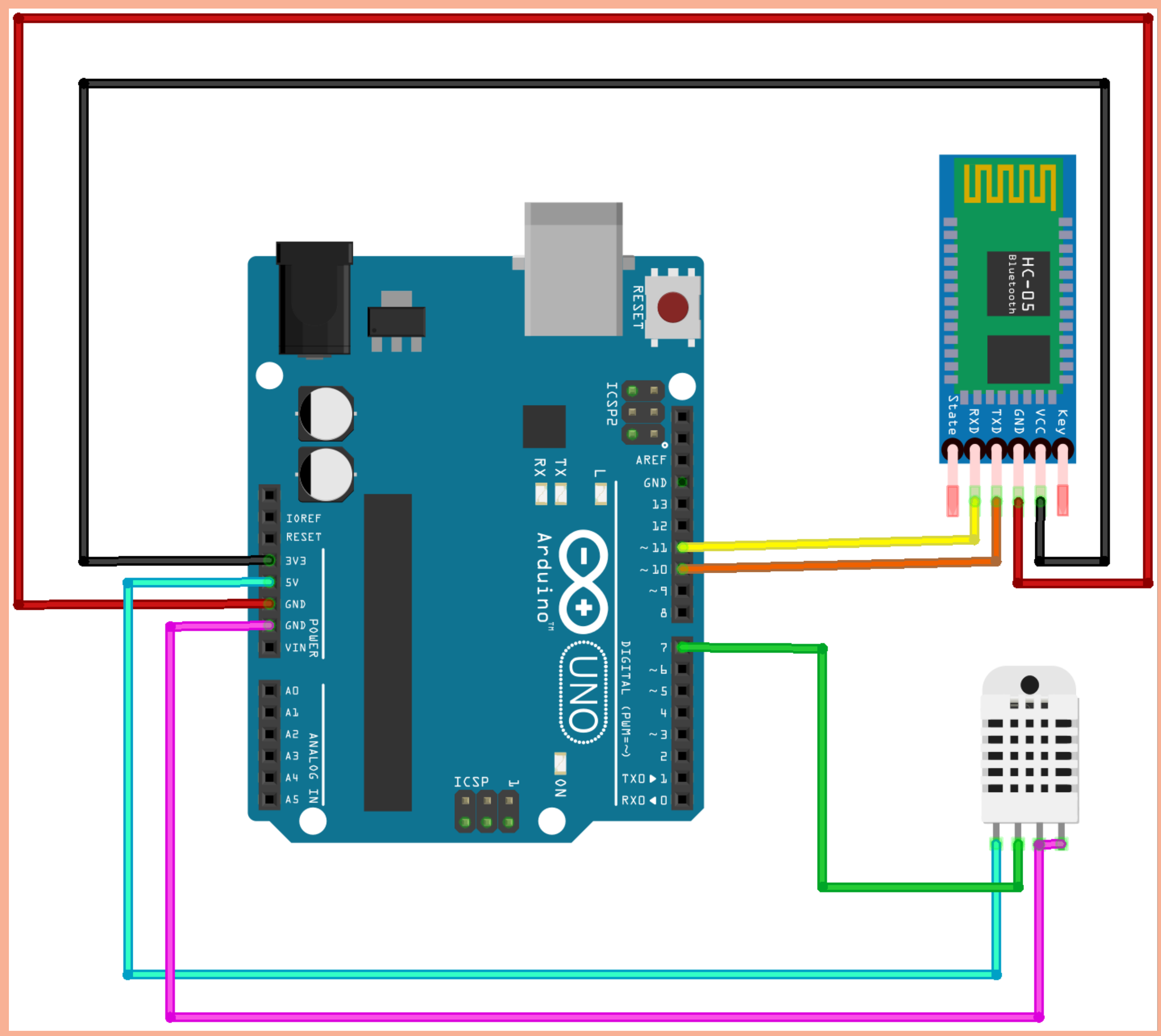

Figure 3: Slave node diagram

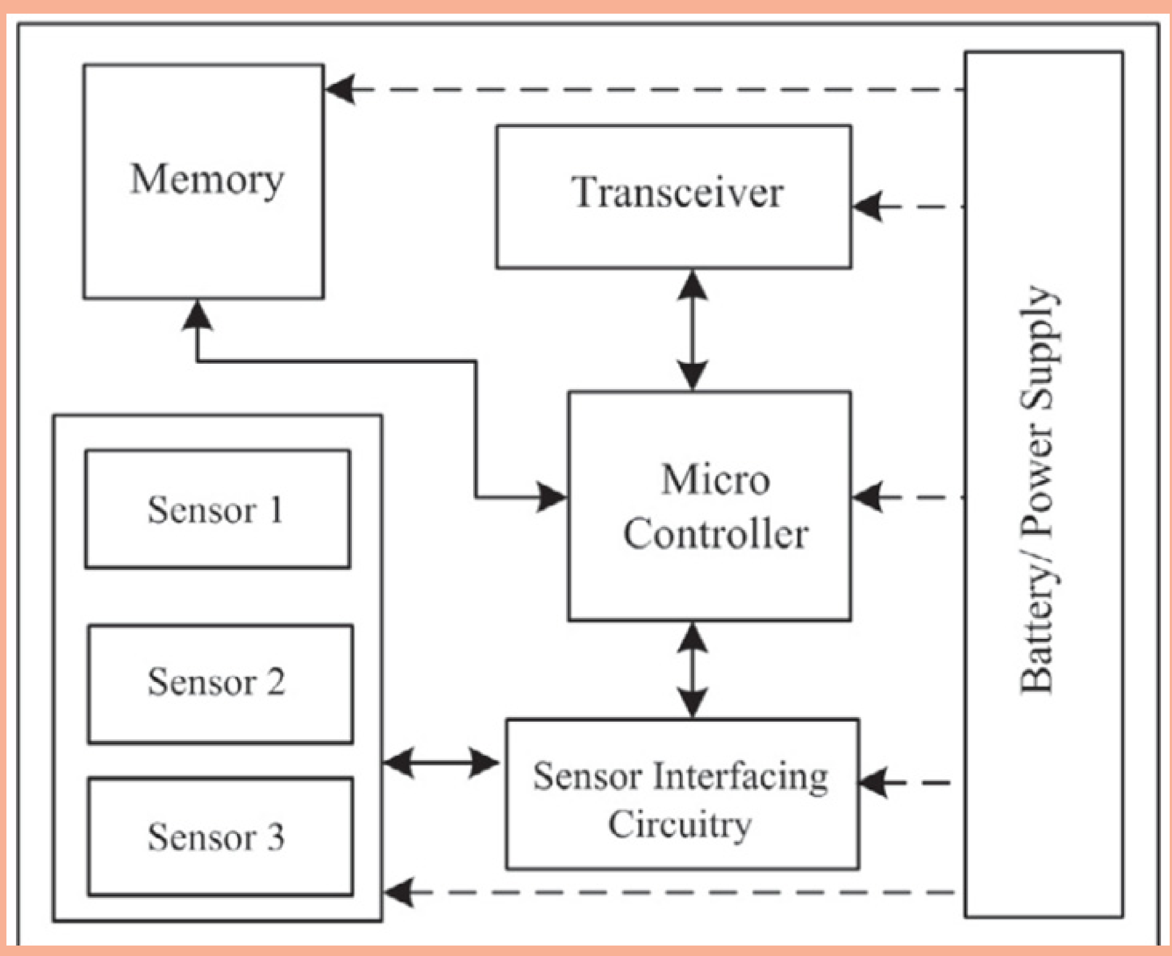

Figure 4: Slave node hardware architecture

DATA VISUALISATION

Temperature and humidity data gathered from the remote nodes is presented in a Processing visualisation which also shows which node was read last, along with timestamps, temperature graphs and network status. *Figures 5* and *6* represent normal operation, whereas *Figure 7* shows an error state that was automatically identified and is being resolved.

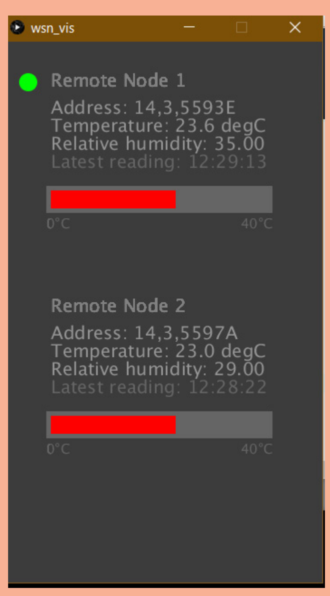

Figure 5

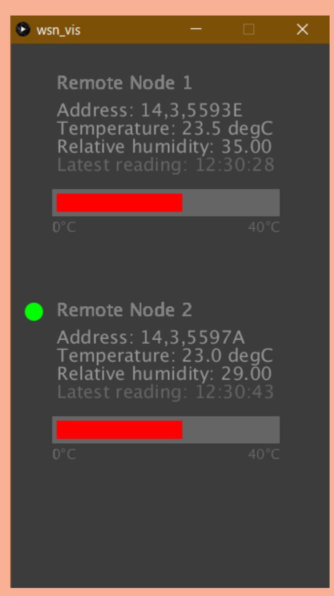

Figure 6

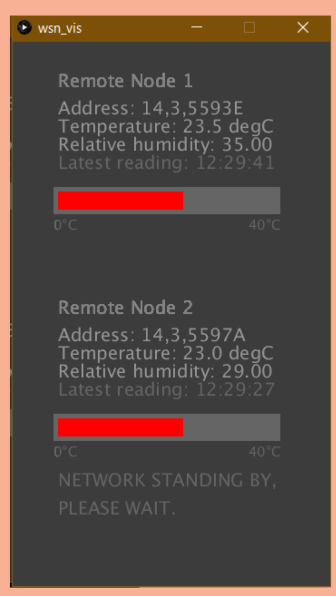

Figure 7

CONCLUSIONS

The Wireless Sensor Network implemented as part of the project met all of its requirements laid out in the Requirements Specification. Operatinal rage is upward of 10 metres indoors, remote nodes operate on battery power efficiently enough to last for days and provides reliable data for its surrounding environment.

Issues such as RF interference, connection stability and power requirement optimisation were addressed during the implementation and testig phase of the project, leading to a final product that is reliable and robust enough to detect error conditions and resolve them automatically, ensuring continuous operation.

REFERENCES

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