Wireless Control via Bluetooth

Asta Andresdottir, IEA, LTH December 2009

In 2007, two students at LTH, IEA began building a personal transporter. The project of building and controlling the transporter has not been completed, there are some tasks yet to be fulfilled. One of these tasks is to set up wireless transmission between the transporter and a controlling computer, which is the project described in this article. The wireless system is a development tool for control algorithms and will not be a part of the final vehicle.

The project includes programming a microcontroller and setting up Bluetooth chips, adapters and converters. A simple control algorithm is implemented and used to calculate control signals. The transporter is not fully operational and the control can therefore not be evaluated as it should be, instead the evaluation is twofold. On one hand the transmissions back and forth can be verified and tested using a signal generator and an oscilloscope. Furthermore control is applied to a DC motor to verify that wireless control can be carried out via the link.

Bluetooth

Bluetooth was invented in 1994 by Sven Mattisson at L. M. Ericsson of Sweden. Bluetooth operates at the unlicensed 2.4 GHz industrial, scientific and medical frequency band, ISM. The Bluetooth waves can travel through substances, which means that line-of-sight is not needed. Household appliances, such as microwave-ovens, baby monitors and cordless phones, use the same band and therefore some disturbance might be expected. Spread-spectrum frequency hopping, SSFH, is used to minimize disturbances. The transmitters change frequency 1600 times per second, which means that each time slot is 625 micro seconds. This reduces the risk of interference and if an interference occurs the disturbance time is short.

The Transporter

The first transporter was introduced by Segway in December 2001. The transporter has two wheels, a footplate, shaft and handle as seen in Figure 1. The driver stands on the footplate and steers the transporter with the movements of his/her own body. The driver leans in the direction that he/she wants to travel and to slow down the driver moves back to the vertical position and then eventually comes to a complete stop.

Figure 1: A Segway transporter, model i2.

The Microcontroller

The microcontroller used is PIC16F73, which comes from Microchip. It is programmed using C programming language. The microcontroller is used to control the communication between the transporter and the Bluetooth chips. Incoming measurements arrive through the on-chip A/D converter and digital ports are used to forward control signals to the transporter via a D/A converter. When the DC-motor control is applied the pulse width modulated, PWM, output is used instead of the digital output and the D/A converter. The set up is shown in Figure 2.

dSPACE Control System

The dSPACE Control System consists of both a hardware and a software part. The software is the ControlDesk that displays variables and gives access to tunable parameters. The hardware consists of a digital signal processor and connection interfaces. A model can be implemented in C programming code or built in Simulink and translated for dSPACE.

Conclusions

An 8 bit signal can be sent and received with the wireless Bluetooth link. Some problems occurred with buffer overflows, which were eliminated by tuning the sampling of signals. The range of the wireless link is close to 40 m and should be enough to develop control for the transporter. Depending on the amount of signals, that affect the control of the transporter, a multichannel link might be desirable.

Future Work

Future work includes more channels for communication, improved set up of the circuits and to add a portable power supply. Future work for the Segway task includes control development and a connection to the sensors of the transporter.

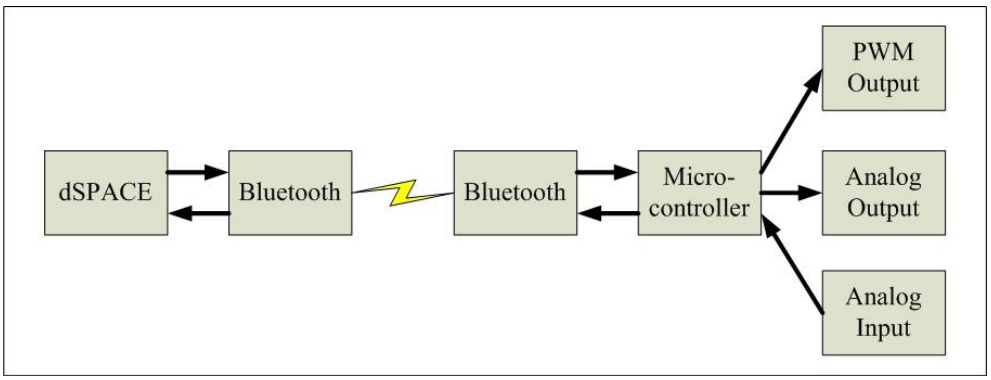

Figure 2: A block diagram of the system