<HarmO>

A computer controlled 6-octave reed organ with touch control, swells and individual registration. The starting point for this construction was an old suction reed organ, of which we only kept the reeds and the key springs. A new electric compressor was added (a small Laukhuff Ventola, rated for 80mm H2O pressure (800 Pa) and 3000 l/min) replacing the bellows. The instrument has 4 sets of reeds for the bass side and 4 sets of reeds on the treble side. In addition it is equipped with 1 octave (13 reeds) of reeds for a subbass. These sound the notes 12 -24.Taking the registers into account, the real sounding ambitus ranges from midi note 12 to 113, or an impressive eight and a half octaves! Two swells are provided, as well as a reflective tremulant mechanism. In total the organ has 305 reeds.

As usual in our automated instrument designs, we designed a sturdy welded frame made in stainless steel for the entire magnet and electromechanical assembly. Other than in our first robot reed organ, here we decided to leave the original keyboard in place. As a consequence, it becomes possible to play the organ in the traditional way even in combination with automated playing. We used tubular solenoids, 20mm in diameter, to activate the keys here serving as levers to reduce the required force to push the pallets down. This saved us the work of replacing all pallet springs with lighter ones as we did in <Harma>. Since the magnets are wider then the distance between keys/pallets (13.5mm), we had to mount them on alternating rows. This became another reason for not activating the pallets directly. The eight registers are each divided in a bass and a discant unit. Gradual opening of the dynamic shutters appeared to be an interesting feature worth implementing. Our first attempt using soft shift linear solenoids to this end were not successful because these solenoids did not produce enough pulling force to guarantee a smooth action. Therefore we finally decided to use linear stepper motors with a threaded shaft. This approach makes a smooth action possible at the expense however, of some extra noise caused by the audible stepping frequency. Although this mechanism is relatively slow in action, the big advantage of it is that it draws no current to keep position, but only so on movement. The whole traject from closed to fully opened takes about 500ms.

The tremulant makes use of the Doppler effect to create a slight but real vibrato. Therefore we needed to build a reflector mechanism driven by a variable speed DC motor.

The radial compressor used for the wind supply is equipped with a wind regulating slide mounted on the inlet of the windchest. This slide can also be controlled and allows for faster wind pressure changes than can be achieved by regulation the rotation speed of the motor. This slide is driven by a stepping motor coupled to a dented belt.
Although in the design phase we considered making the instrument fully polyphonic, we finally decided to limit polyphony on this automate to 32 notes. For a full 73 note polyphony would have implied the construction of a hefty 45A / 12V power supply. Even though possible, the compressor would never have enough wind to make all the reeds sound. Thus we decided to forsake full polyphony. Even at 32 notes held simultaneously the wind supply is barely powerful enough.

<HarmO> is controlled by 11 PIC microcontrollers (6 for the notes and the registers, 3 for the linear stepper motor controllers, 1 for the compressor motor, 1 for the lights, the motor control signals and the tremulant) and takes midi input directly. <HarmO> was designed from the beginning on with velocity control but the effect of touch sensitivity is of course by far less effective than it is on our player piano or on the organs equipped with conical windchest valves such as <Bomi>. However, any touch sensitivity a reed organ played by a human might have, is also implemented and at least surpassed in this robot.