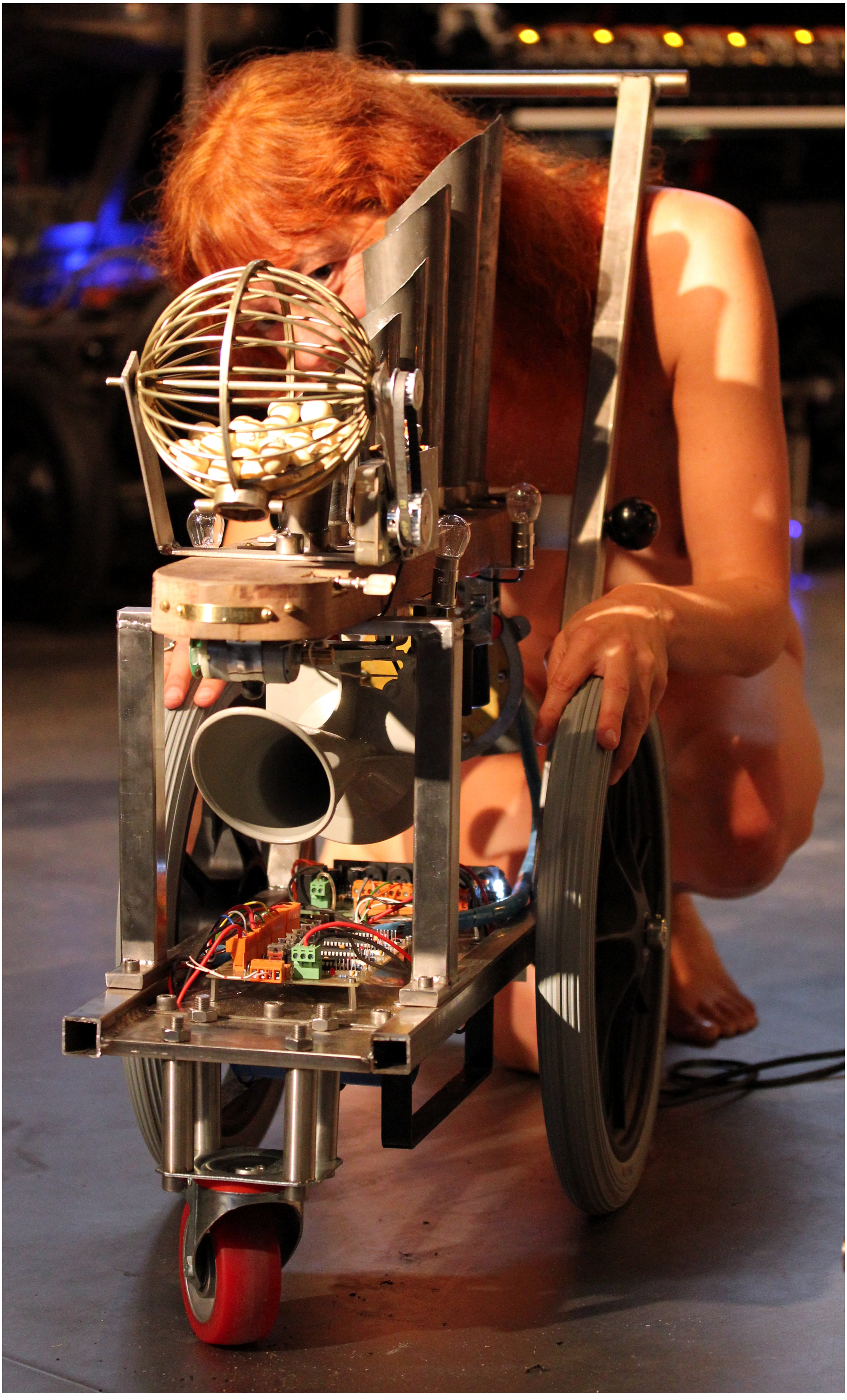

<Whisper>

This robot is very silent by design. It's sound production is based on the cavity resonator. In daily life people may have run into such sound generators as they are often used as a whistle on some water cookers. They find extensive applications in bird calls of different kinds and in quite a few toys (rubber ducks) and simple toy instruments. All these are designed to be blown (or suck) with the mouth or a small bellow. From an acoustical point of view cavity resonators at first sight appear to be Helmholtz resonators: there is a cavity of air and two orifices on opposing sides of the cavity. However, the math around them does not seem to apply here. Properly speaking a Helmholtz resonator ought to have a single well defined resonant frequency lacking overtones, whereas the cavity resonators under consideration here operate over a range of more than an octave and produce a manifold of non-harmonic sounds and noises, including multiphonics. The main reason for this behavior seems to be that our resonators are driven by turbulent air of very low pressure and hence the dominant sounds produced are edge tones around the orifices. It is known from organ pipes that the frequencies of these edge tones are highly dependent on applied wind pressure.

We started off by constructing a wide variety of cavity resonators. Small flat cans gave good results and had a quite wide pitch range under varying pressure conditions. The addition of a conical secondary resonator increased the sound level quite a bit, although it greatly influences (and limits) the pitches obtainable. After a lot of experimentation we decided to construct these conical resonators with the large end cut under an angle of 45 degrees, this to make the resonant frequency less pronounced. These cones were made from a tin-lead alloy. The cavity resonators were glued inside the tapered end of the cones. We made stainless steel flanges to mount the resonators and their cones on the windchest.

Sofar we have no sound explanation for the observed difference between calculated and measured resonances. We might assume turbulencies play a major role here, and maybe the velocity of sound, taken as a constant in the calculations cannot be considered constant. As measurements on the propagation speed of sound in cavities and coupled cavities seemed to be in order, we performed some initial measurements using a pair of measurement microphones and an oscilloscope set up for delay measurement between two input channels. We used an electronic metronome as pulse source, placed as close as possible behind one of the microphones. The measured propagation speed of sound through constricted channels was ca. 10% lower than the speed in free air. The difference is substantial, but apparently not large enough to thoroughly explain our mystery...

The little fans to cause the turbulent wind work on a 12 V DC voltage but they easily can withstand 16 V. It should be noted that this instrument works on suction wind! We have no clue as to what explains the fact that suction wind works better, given the inherent symmetry of the resonators.

The rubbed string component is based on the same sound generation principles underlying Luigi Russolo's Intonarumori. He used a crank driving a wheel over which a piece of gut string (the tension could be controlled with a hand lever) was led. The other side of the string being attached to a membrane connected to an amplifying horn, a linear cone in most of his instruments. In our design we used a metal membrane coupled to a flared cone taken from an old alarm buzzer. The crank with wheel in the Russolo design, was replaced by a small high torque Johnson motor powered by a variable DC voltage

The three small shakers on this robot were made from empty 35 mm film cans filled with iron or lead granules. The shaking is activated by A.Laukhuff pallet lifting solenoids. On the front of the robot, we mounted two cast bronze sleigh bells activated by a somewhat larger solenoid.