# Precision Flow and Measurement of Helium Gas for High Altitude Application

Mueller, Niko

High altitude balloon research conducted by universities and government research teams like NOAA and the EPA are expensive projects. The total equipment value for an average flight exceeds $4,000 plus hundreds of man-hours in research and assembly. Traditional launches are based on the "ballast method" in which all flight equipment is weighed; balloon, rigging, and parachute. A target ascent rate and altitude are then determined. The balloon is filled until it can lift the equivalent mass of the ballast bag. Procedures are done outdoors, so surface winds skew lifting conditions. Balloons can easily be mis-filled; resulting in slow or rapid ascents that burst early; producing unsuccessful results. Hazards to missions include balloons stalling in the jet stream, traveling much further than the recovery team can manage, and danger to passenger aircraft. Resulting poor data, and lost or damaged research equipment requires a better solution. Integrating a microcontroller with a digital air flow sensor, measured the helium gas flow to the balloon in liters per minute (LPM) and a Liquid Crystal Display (LCD) showed fill rate and quantity status. The sensor and LCD both required Inter-Integrated Circuit (I2C) software to communicate and display status to operators. This project developed the technology for filling balloons quickly, at a controlled, known flow rate (LPM) of helium to a precise volume of gas for a given mass, based on the density difference of air displaced by helium (1.20gr/l v 0.18gr/l or 1.02gr/l net lift) ending the ballast method, providing greater accuracy for future launches.