This thesis presents dynamic range extension techniques for CMOS image sensors tailored for low light applications. The standard dynamic range of a CMOS imager is 50-60 dB. A high dynamic range (HDR) CMOS image sensor has the ability to capture a greater light range. Thus, it can successfully reproduce the high contrast information in a scene. The dynamic range of a CMOS image sensor in low light is limited by the noise floor of the sensor. Enhancement of dynamic range in low light requires suppression of the electronic noise or modification of signal readout such that it can overcome the electronic noise.

This thesis is motivated by the need to have low light sensing imagers without compromising on the power and area budget especially pixel area. The techniques presented focus on signal amplification, low frequency noise suppression and time domain readout for high dynamic range. All techniques involve minimal additional hardware that does not introduce noise of its own and does not require process modification. They are compatible with existing standard fabrication processes and require minor or no changes in the standard 3T and 4T pixel architectures. Thus, they are simple to implement and cost effective. Moreover, the dynamic range is user programmable which assists the user to optimally decide the required range and simultaneously have control on other performance parameters like sensitivity and frame rate. The flexibility provided by the proposed techniques should make their inclusion in low light sensing applications straightforward and effortless.