Eliminating Data Loss in a Foundry Wireless Sensor Network

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Extended Abstract

This paper outlines the development of a robust wireless transmission system for use in a wireless sensor network (WSN) application for an aluminum casting foundry. The focus is on 100% retrieval of sensor data. The lost foam casting technique is a method for casting intricate shapes from aluminum. A polystyrene mold is created in the desired shape and placed in a flask with a sprue attached. The mold is then covered with sand. When the molten aluminum is poured into the sprue, the hot metal melts away the foam and fills the mold. Casting defects can occur using the lost foam technique. Capacitance sensors were developed at TTU to provide a system for monitoring metal fill. Analysis of the sensor data can lead to understanding the parameters affecting casting defects and ultimately reduce or eliminate them. Due to safety hazards in the foundry, wireless transmission of sensor data was required. Mica2 Mote hardware was used to wirelessly transmit data from the capacitance sensors at the flask to a PC on the other side of the foundry. Analysis of sequencing numbers of the transmitted data packets showed that some packets were lost during transmission. Data loss increased as more motes were added to the system and when moved from the lab to the foundry. Incomplete data does not allow for complete analysis of the metal fill, so a system was developed to ensure 100% data retrieval. The Motes were programmed to log the sensor readings to their onboard memory as well as transmit them wirelessly. Each line of memory holds 8 sensor readings, so packet length was also chosen to hold 8 sensor readings. This system would allow missing data to be retrieved from the Motes' memory if initial wireless transmission failed. At the receiving PC, a LabView application was developed to interact with the sensor network. Much effort was invested in achieving successful communication between the 2 platforms. At the start, the PC application issues a start command packet to each Motes in the system. These command packets were offset to reduce channel contention for incoming data packets by providing discrete windows for each Mote to transmit. Eliminating channel contention reduced lost packets, but did not eliminate them entirely. The PC application parses and logs the incoming data packets to a file and keeps track of missing packets by examining the sequence numbers. When missing packets are detected, a command packet is sent to the appropriate mote to read the corresponding line of memory and retransmit a packet containing the missing data. A log of missing packet numbers is kept in case the retransmit is unsuccessful. When the stop button is pressed, stop command packets are sent to the Motes. All remaining missing data are requested again. Using this system, 100% of data was successfully retrieved. The system is limited by the circular buffer structure of the Motes' onboard memory. When the buffer is full, the earliest data is overwritten. Using the sample rate suggested by developers of the capacitance sensor, the duration of most metal pours was shorter than the limit imposed by the memory size. Refinement of the starting mechanism to avoid dropped start commands is needed, as well as testing during live metal pours. This system was successful at ensuring 100% retrieval of sensor data in the foundry.