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Wireless Network of Indoor Air Quality Sensor (WINoIAQS)

Chapter I. Introduction

With the rising cost of energy and the movement towards making homes green, many homeowners are weatherizing their homes with disastrous consequences. A house that has been rendered air tight is very energy efficient however without proper ventilation this can lead to an excessive build up of unwanted and potentially deadly gases. Without an effective method of monitoring these gases some homeowners find themselves in the hospital or worse.

Monitoring air quality in a house or office is vitally important for the health and well being of the occupants. Toxic gases come in many forms and from numerous sources. When the concentration of these gases are low there is very little or no adverse health problems, however the consequences of exposure to excessive amounts of these contaminants range from potential cancer to mild headaches and problems sleeping. Since exposure has such a drastic range of health problems, identifying the fact there is a problem is, in itself, a problem. Many people do not immediately associate mild aches or tiredness with a build up toxic gas.

Toxic gases are not the only problems that can arise when it comes to air quality. Indoor air contamination can come from many sources, such as moisture, heat, various building materials, heating/cooling systems, and even common cleaning supplies. By monitoring the presence and quantity of these contaminants, homes can be kept safe for inhabitants. While not all airborne pathogens can be measured directly, many, such as mold can be monitored indirectly. Since mold thrives in warm, humid environments, growth can be eliminated by ensuring the room is kept dry and at a reasonable temperature.

Many indoor air quality monitoring systems available on the market today monitor temperature along with only a couple other parameters.Normally this system is simply a hand held device used to make a single ‘snapshot’ measurement. These devices to not give a wide enough range of data to draw an educated conclusion about the safety of a home. While a hand held unit is useful for a quick check, it is not effective at monitoring the space during periods of high traffic and low traffic in the home. Levels of gases can fluctuate greatly by simply being in the room, opening a door, or taking a shower. Being able to monitor a room in its “natural” state would provide very useful data to anyone concerned about toxic levels.

A single unit that can monitor multiple parameters in multiple rooms would greatly aid in the monitoring of the air quality of homes for a long period of time. This single unit would help reduce the cost to the user and greatly improve efficiency.

Chapter II. Problem Definition

The purpose of this project is to create a system that monitors many indoor air quality contaminants in each room of a home separately and reports the data via wireless communication to be displayed on an easy to read user interface. This system will be used to monitor the indoor air quality of homes for periods of time ranging from days to years. The data collected will determine which contaminants are present, in what quantities, and possibly help determine the cause of these contaminants.

The base unit is already in place and reporting CO_2 levels to the internet via ethernet cabling. The data is represented graphically on an open source user interface. The improvements upon this unit would include multiple satellite modules that would report the findings to the base unit. These units may be efficient enough to run on battery power for a short time in case of a power loss, but will be designed to plug into a wall for long-term monitoring.

The majority the project will be broken into four separate sections.

Wireless- Successfully transferring data between individual nodes and the base station. This will be done with either UART or SPI languages. Each individual node will need to report all data collected in a specific order to the base unit on a time triggered response. While communication will be primarily one way, the base unit must be capable of “triggering” an individual satellite node and requesting the data. The node will then acknowledge the request and send the data.

Sensor- Number of sensors and communication method used will dictate the size of the controller needed. The three primary sensors that will be Incorporated are temperature, pressure and humidity. These sensors must be able to operate reliably for long periods of time. This is particularly important in regard to the node that will be placed outdoors. Since this is Montana, it will be required to operate with minimal error in industrial temperature ranges (-40-120 degrees C). The other sensors in the system (indoor nodes) may have more forgiving parameter requirements, meaning they may use different sensors all together. Once these three sensors are working correctly, expanding the sensors to include sensors that detect formaldehyde, flammable gases or carbon monoxide should not be much of an issue.

Controller- A micro-controller will be required for the operation of each node. It must retrieve data from the sensors in a specified order, and send data to the wireless module. Since the data will only be sent once every specified unit of time, a system will need to be in

place to ensure the nodes are only sending data after requested by the base unit. The micro-controller must also have the capability to ‘wake up’ a sleeping node to request information at the discretion of the user. It is not required to be extremely fast for the application of this project.