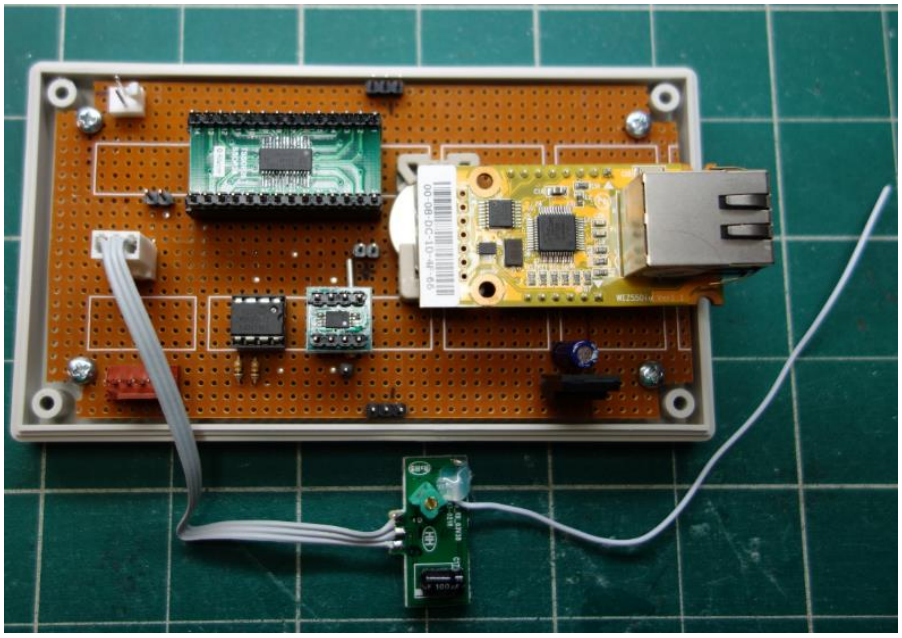
Abstract

"A little peace-of-mind for those living alone"

As our population ages, the challenge of providing assistance to those living alone becomes greater. This project uses the WIZnet WIZ550io module, a microprocessor and an array of commercial and specially built sensors to provide a minimally intrusive observation system for a resident wishing to live alone. This system provides the peace of mind that she or he will immediately have assistance if they encounter difficulty.



The key to the system is the WIZ550io module that allows alerts to be sent to a remote caregiver if the resident's activity patterns deviate substantially from a normal profile. In this way the caregiver (a friend, relative or professional) can monitor the resident without constantly having to contact or disturb them. Privacy is maintained since no video surveillance is involved yet security is enhanced because movement within the residence, as well as the use of appliances and furniture, is monitored around the clock. A block diagram of this system is presented in "WZ1266_Block_Diagram".

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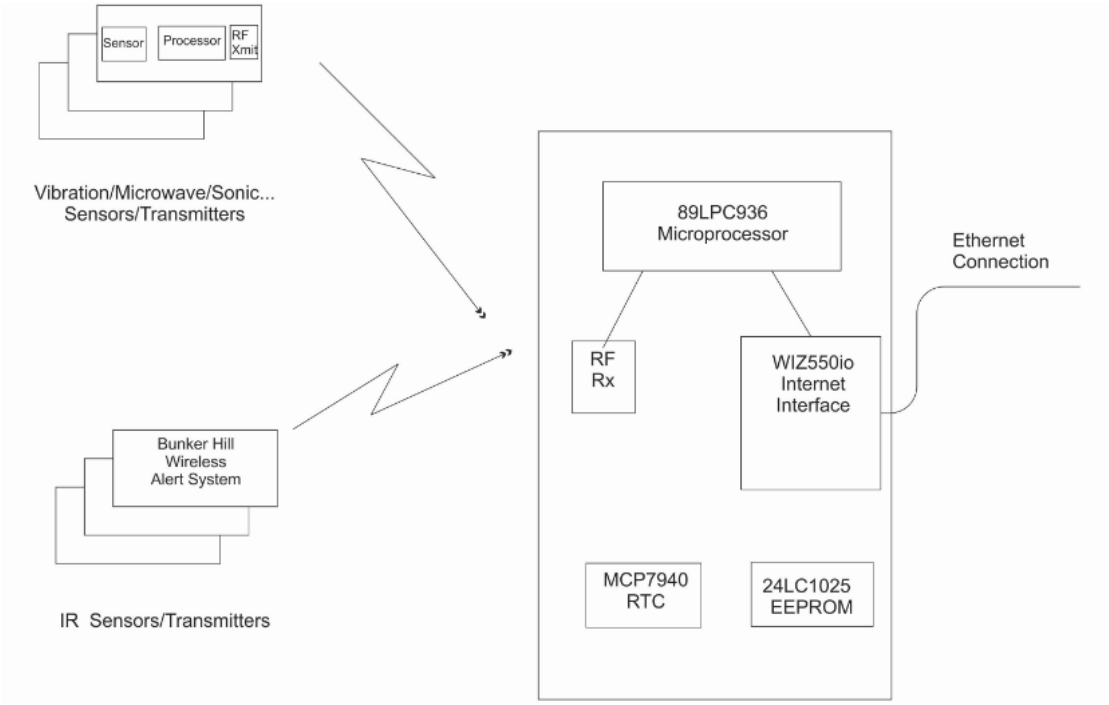
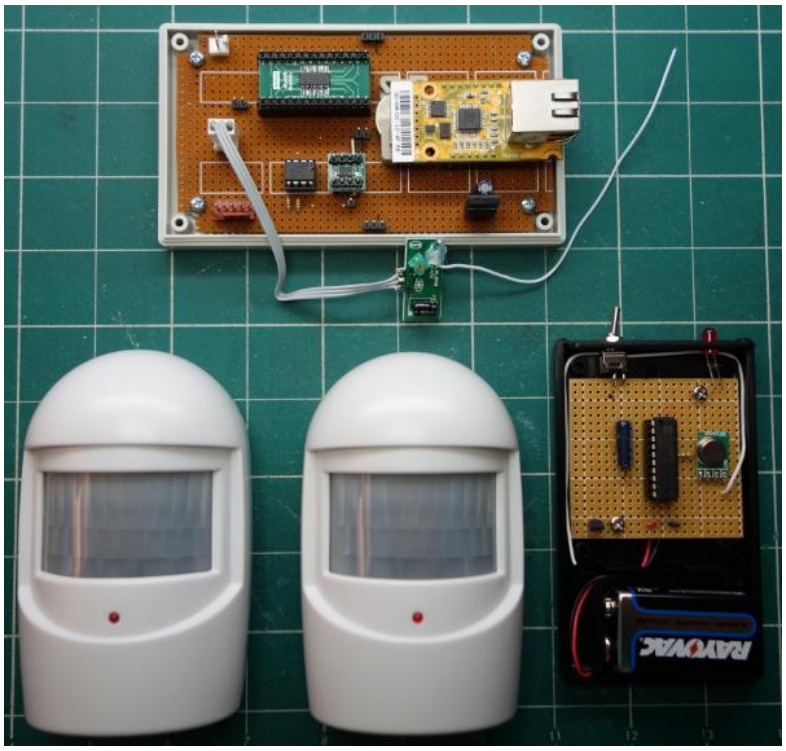


Wz1226 Block Diagram

The monitoring system uses an array of IR motion sensors that sense the presence of an individual and report activity to the processor over an RF link. These sensors, widely available and very inexpensive, are backed up by custom sensors that record activity in chairs, beds or sofas and that report this data over the same RF link. This system can also include ultrasonic, microwave, pressure mats and other personnel reporting devices. Expanding still further, this same system can include sensors for current flow (how long has the stove been on, or the lights?), temperature (is it in a comfortable range?), water flow (has a tub or shower been left running?), flame sensors (has the stovetop been on for too long?) and many other devices that let the processor decide if the activity is normal or if the caregiver should be notified. All of these devices report detected activity to a microprocessor that compares this activity to a normal pattern to decide if a caregiver needs to be alerted. This microprocessor also logs all data so patterns can be examined to fine-tune the rules defining normal activity.

Ease of use was a major consideration in designing the system. Either the resident or the caregiver will be installing the system so an easy-to-use interface was a must. The process begins with the processing module (containing the WIZ550io) being plugged into house power and an Ethernet port. (The photo " WZ1266_Photo2_System_Components" shows the base unit, two IR sensors, and the custom vibration sensor.)



A server operating in the microprocessor then presents a display of the system to the user through a client such as Firefox, Safari, or other browser that allows the user to configure the sensors and the system for the resident. This display page is shown in "WZ1266_ScreenCapture_SetUp". The user first places batteries in each of the sensors and as they are recognized by the system a name can be assigned to them using this browser interface. Names are then assigned to rooms that are to be monitored and the sensors are then assigned to these rooms. These sensors are then positioned in the room where they have a clear view of the area. The motion sensors are attached with double sided tape to the bed or furniture they are to monitor.

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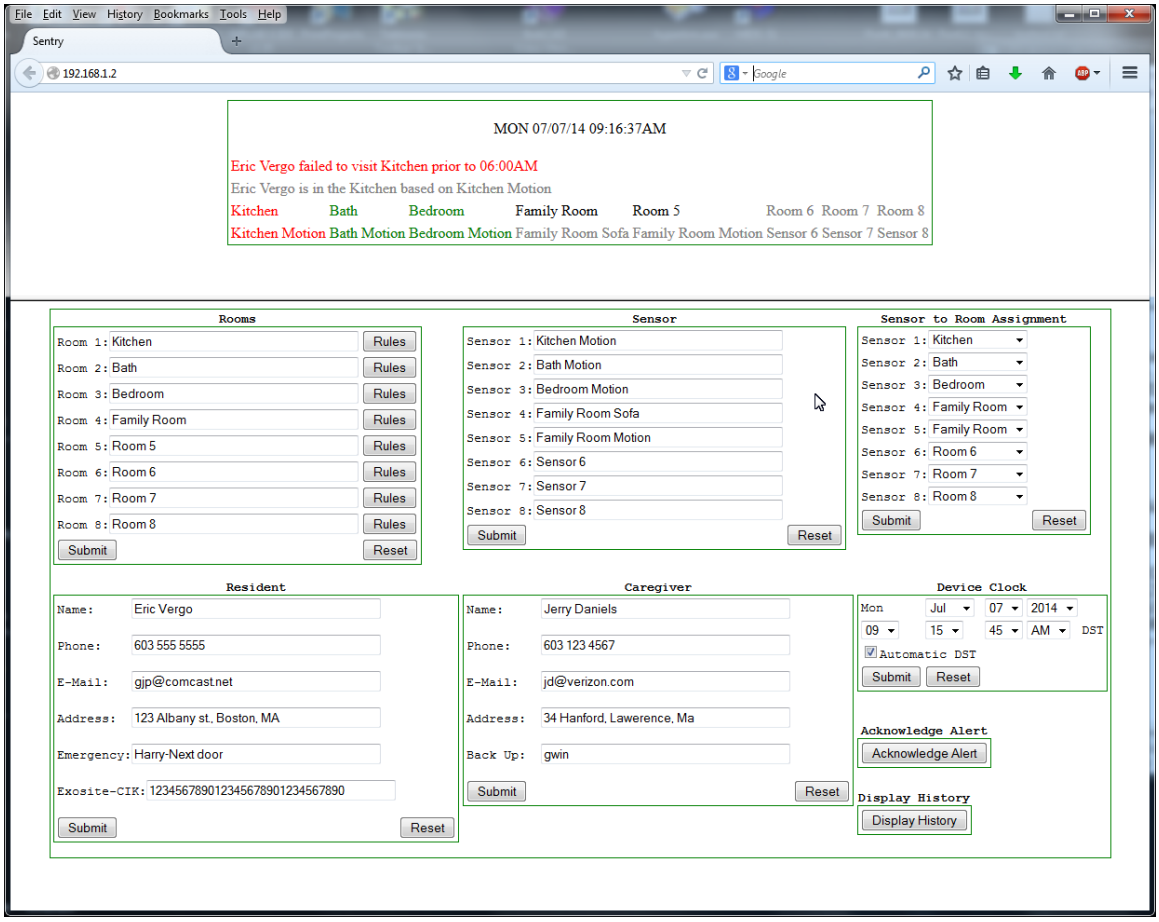
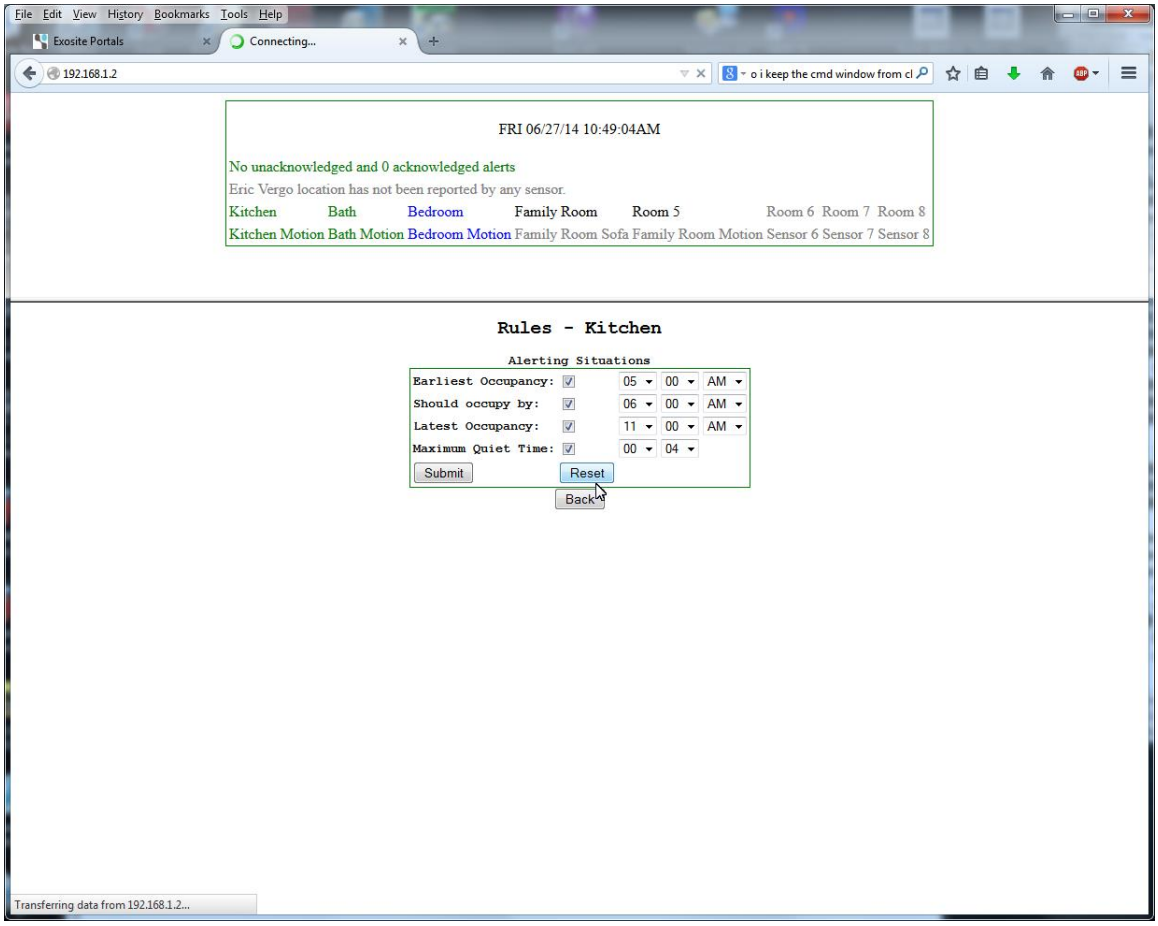


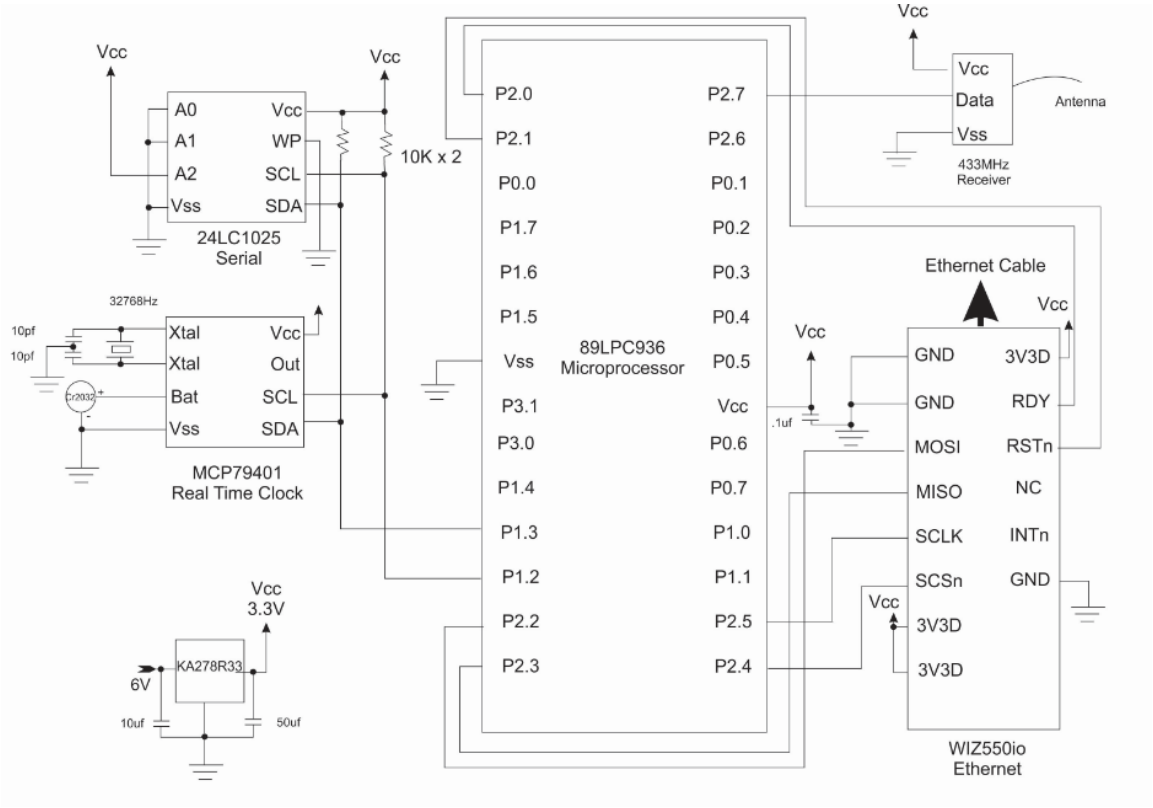
Each room has a set of 4 rules that define normal activity about the house. These rules are established using the web page illustrated in "WZ1266_ScreenCapture_Rules".



The first rule is the Early rule which indicates the earliest time activity should occur in a room. The second rule is the Should rule which indicates when a room should be occupied, while the third rule is the Latest rule which indicates when a room should normally be vacated. The last rule is the Quiet Time rule which indicates how long the resident can be quiet in a room before the caregiver is notified. With motion sensors placed on beds, favorite chairs or sofas this rule allows any motion in the monitored furniture to reset this quiet time rule. Each of these rules can be enabled or disabled to build a strict or relaxed set of rules for the resident. Once the device has been configured with the local browser it is then prepared to report alerts and status to the caregiver using a site such as Exosite with SMS messages or E-mails to the caregiver's phone. Having received an alert the caregiver would then normally contact the resident to check on their status.

The implementation of the system was fairly easy since the WIZ550io encapsulated the difficult work of network interface. A schematic of the base unit is in "WZ1266_Base_Unit_Schematic". Processing the RF data stream was accomplished using an off-the-shelf receiver and logic in the microprocessor to interpret the data and build sensor identifications for each unique signal. A real time clock provides the time of day for the system while a 1024K bit EEPROM provides storage of sensor/room IDs and rules as well as a circular buffer for history. The microprocessor runs a server for interface to a local client for establishing and changing the operation of the unit and a

client interface to provide communication to a remote server such as Exosite for alerting the caregiver and generating SMS messages.



The custom sensors which complement the IR sensors are very simple devices consisting of a vibration sensor coupled to the interrupt pin of a microprocessor. A schematic of this unit is viewable in " WZ1266_Vib_Schematic".

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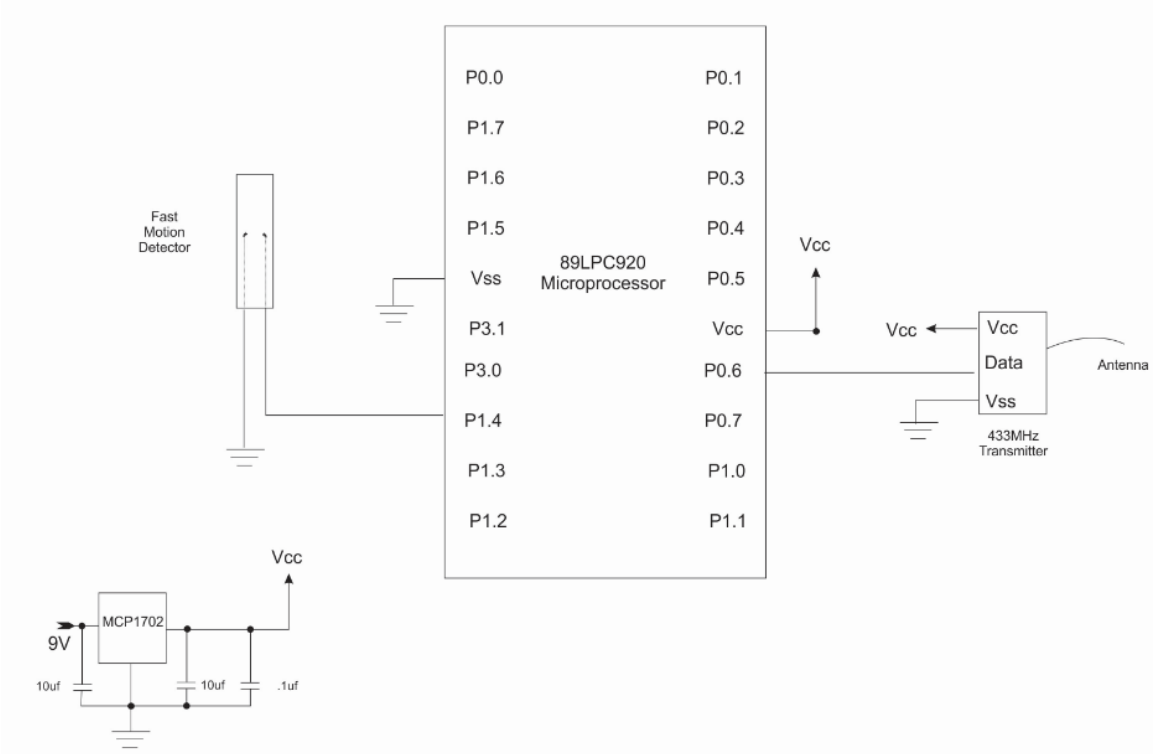
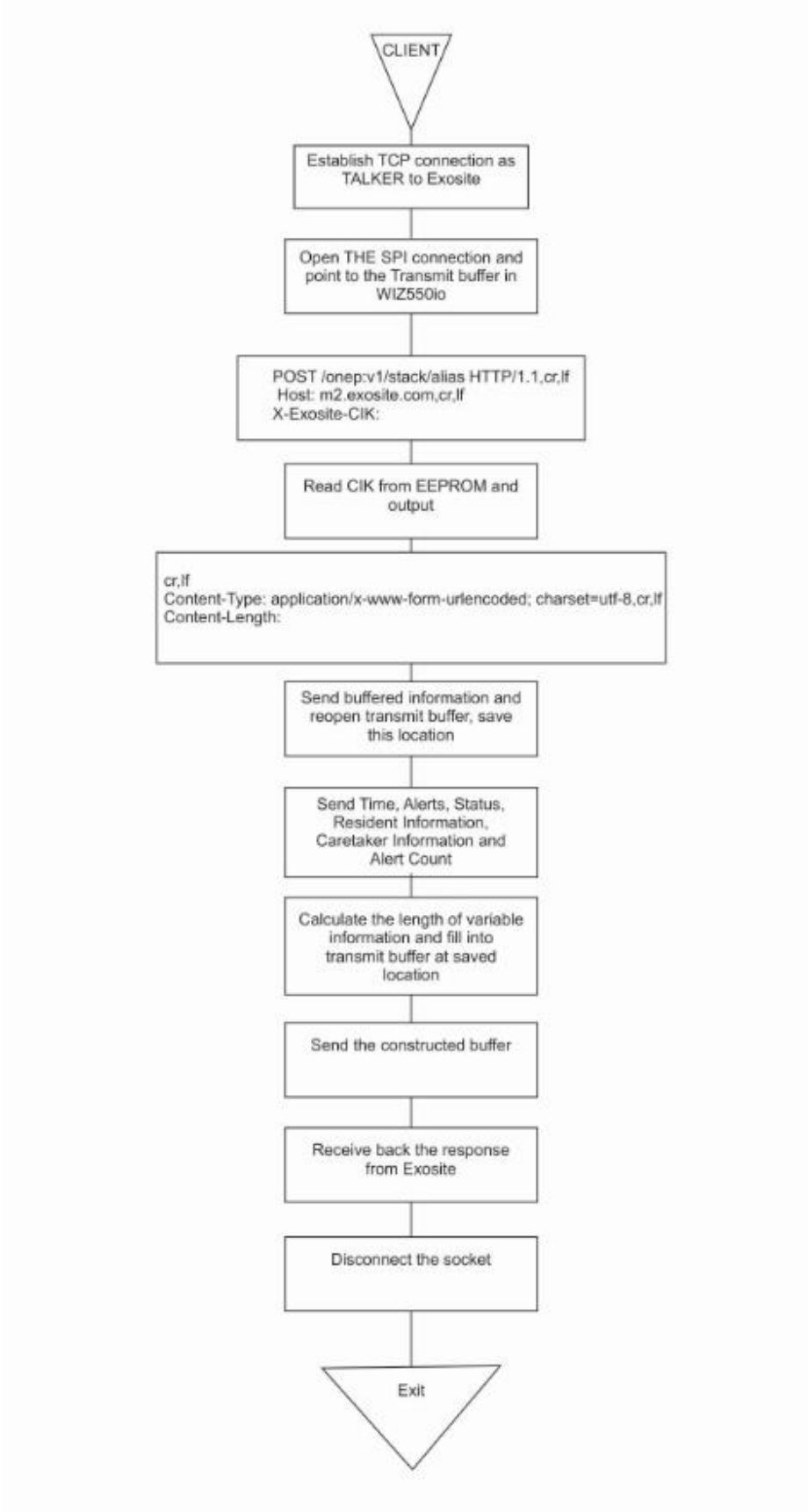


The microprocessor keys a simple RF transmitter to mimic the data stream of the IR sensors. The addressing pattern in this RF stream allows for different blocks of devices with unique addresses in each block. In this way different classes of sensors can be provided that all interface seamlessly with the system. The microprocessor in these sensors is designed for battery operation so it sleeps most of the time and only wakens when motion is sensed, then puts itself to sleep to ignore constant motion.

The hardware in the base unit and the remote units is very simple and uses readily available parts. The software in the base unit is the element that adds significant value to the system. This software is a combination of a polling loop and two interrupt routines. Of the two interrupt routines, one keeps track of time sequences and the second interprets the RF data stream to build sensor identifications. The polling loop processes timed events such as accumulating durations and sending messages to Exosite and also processes client requests from a browser while checking sensor reports to generate alerts. The logic that establishes a client connection to Exosite is illustrated in "WZ1266_Flowchart_Client_Logic".


CLIENT
Establish TCP connection as TALKER to Exosite
Open THE SPI connection and point to the Transmit buffer in WIZ550io
POST /onep:v1/stack/alias HTTP/1.1,cr,lf
Host: m2.exosite.com,cr,lf
X-Exosite-CIK:
Read CIK from EEPROM and output
cr,lf
Content-Type: application/x-www-form-urlencoded; charset=utf-8,cr,lf
Content-Length:
Send buffered information and reopen transmit buffer, save this location
Send Time, Alerts, Status, Resident Information, Caretaker Information and Alert Count
Calculate the length of variable information and fill into transmit buffer at saved location
Send the constructed buffer
Receive back the response from Exosite
Disconnect the socket
Exit

Abstract

The Internet of Things is frequently viewed as collections of devices that we use everyday. This system turns this concept a bit and provides a device that never needs to be considered when things are going normally, but stands by to summon help if it is ever needed.