UNIVERSITY OF PUERTO RICO AT MAYAGÜEZ

MAYAGÜEZ, PUERTO RICO

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

WaveSphere: Progress Report #3

A PROGRESS REPORT SUBMITTED AS A PARTIAL REQUIREMENT OF THE
MICROPROCESSOR INTERFACING COURSE ICOM-5217

by

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1. Operating Charts

Operating charts describe the modes of operation and the flow of the system without much detail. Figure 1 shows the system's main flowchart, which depicts how the device goes in and out of each of its operating modes. A general but brief overview of the different modes of operation follows.

The following sections contain a more thorough explanation of each of the operating modes mentioned, along with a flowchart of its own to help explain what can be done in each one.
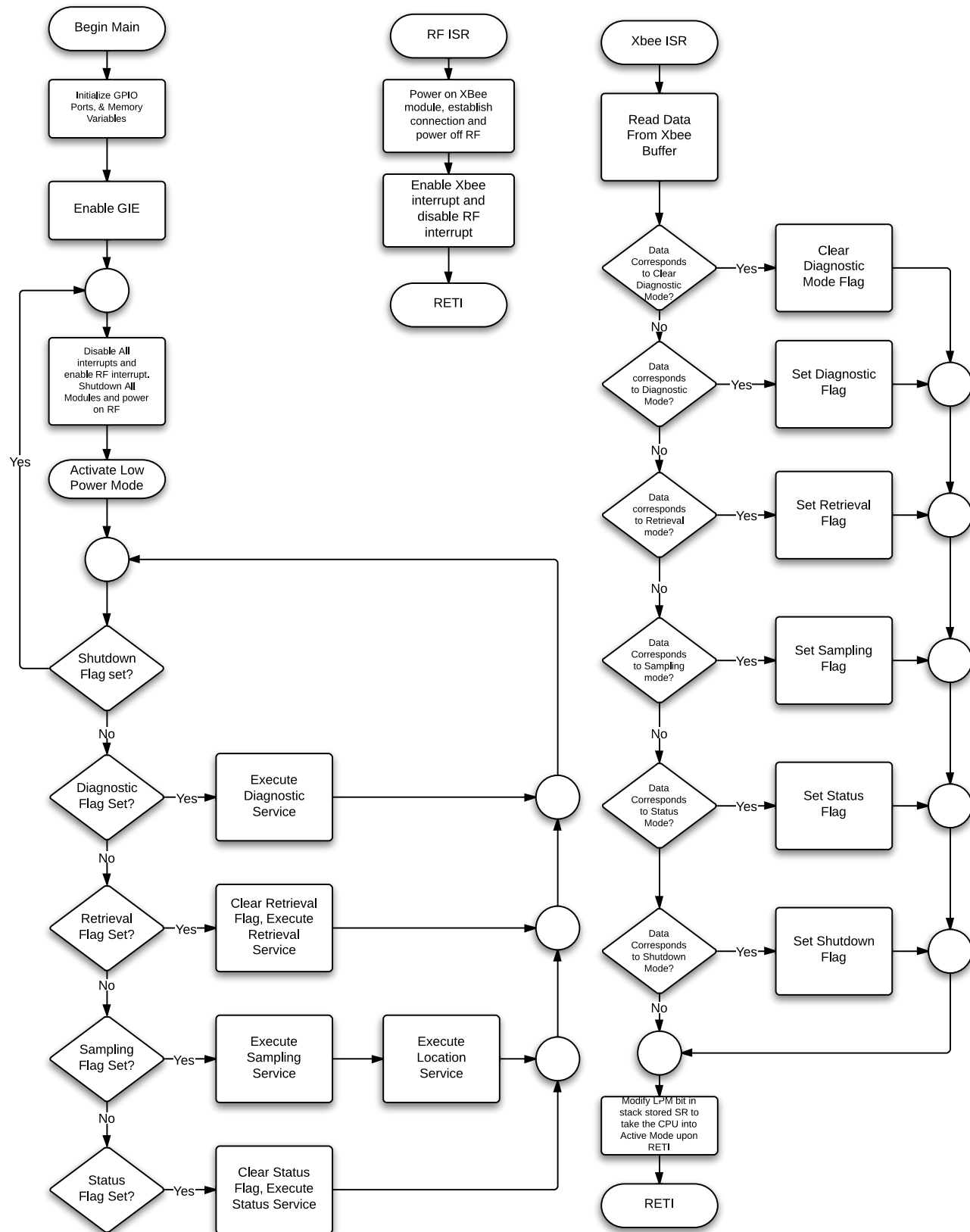
Figure 1: System Operating Chart

1.1 Diagnostic Event Service

On Diagnostic Mode the device maintains communication to the base station and sends real-time information of the different components to the base station, the user can then observe and verify that all components are taking measurements and data can be retrieved through the XBee.
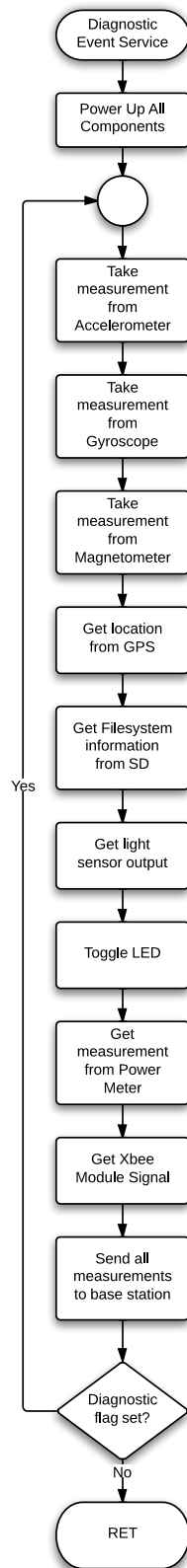
Figure 2: Flowchart for Diagnostic Event Service

1.2 Retrieval Event Service

Retrieval Mode is the operation mode of the device in which the system transfers the data collected while in Sampling Mode from the SD Card to the base station. Data is transferred trough the established ZigBee connection and once all data has been transferred it is erased from the SD card.
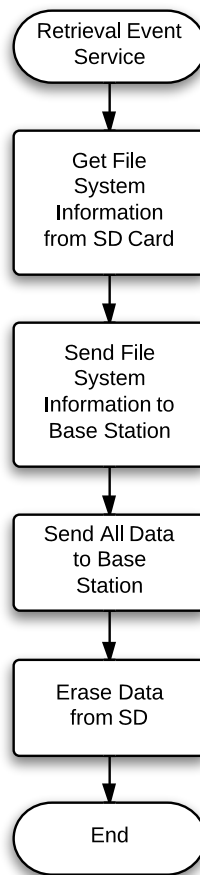

Figure 3: Flowchart for Retrieval Event Service

1.3 Sampling Event Service

On Sampling Mode the device captures data from the accelerometer, gyroscope and magnetometer. Data is captured for the duration of the previously specified time and data points are saved in the SD card, each with a time stamp from the time which they were captured.
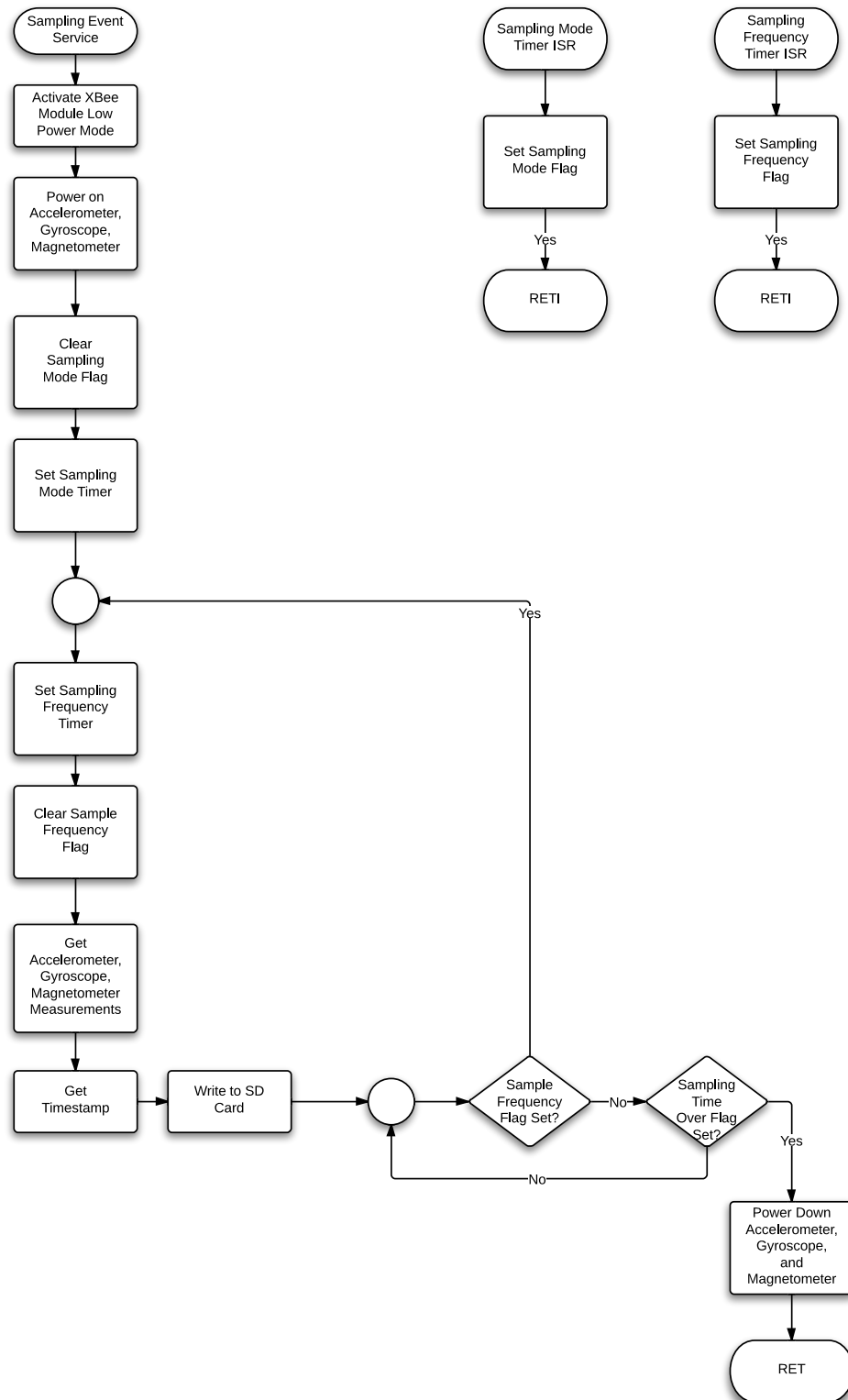
Figure 4: Flowchart for Sampling Event Service

1.4   Location Event Service

On Locate Mode the user is trying find and retrieve the device. The system turns on the XBee Module and the GPS and turns off all other components. The system then proceeds to establishing a ZigBee connection to the base station and get a GPS lock. Once the device gets its location using the GPS Module it will then broadcast the location to the base station through the ZigBee connection. If the on-board light sensor determines that it is dark, i.e. an experiment is being conduted when there is little or no sunlight, then a strobe LED will be flashed so as to facilitate the retrieval of the device.
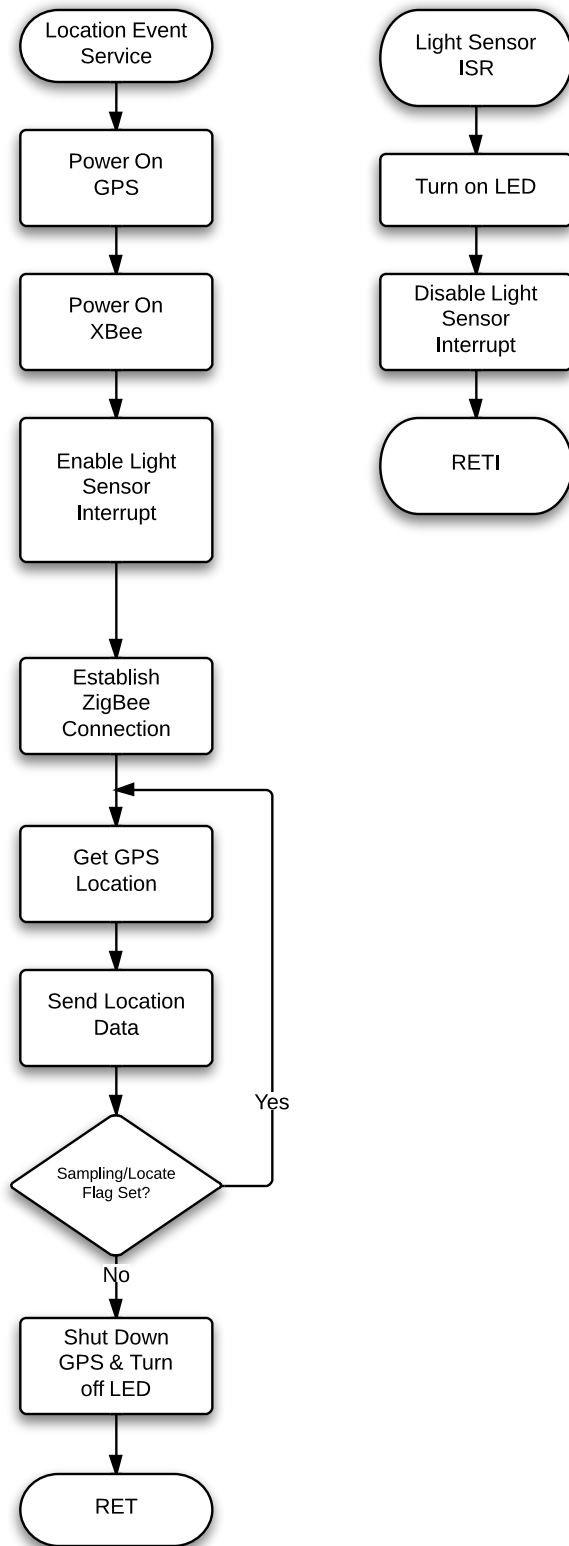
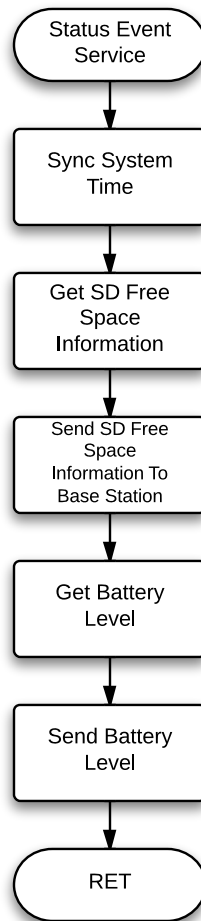Figure 5: Flowchart for Location Event Service

1.5 Status Event Service

Figure 6: Flowchart for Status Event Service

2. Software Plan

This section contains the pseudocode of the embedded software of the system. Algorithm 1 contains the Main function of the system. After the Main, Interrupt Service Routines (ISRs) and Sub-Routines are found in order of appearance.

3. References

Algorithm 1: Main

Initialize GPIO Ports;
Initialize Memory Variables;
Enable GIE;
while *true* **do**
    Disable All Interrupts;
    Enable RF Interrupt;
    Shutdown All Modules;
    Power on RF module;
    Activate Low Power Mode;
    while *Shutdown Flag Cleared* **do**
        if *Diagnostic Flag Set* **then**
            Execute Diagnostic Service;
        else if *Retrieval Flag Set* **then**
            Clear Retrieval Flag;
            Execute Retrieval Service;
        else if *Sampling Flag Set* **then**
            Execute Sampling Service;
            Execute Location Service;
        else if *Status Flag Set* **then**
            Clear Status Flag;
            Execute Status Service;
    end
end

Algorithm 2: RF ISR

Power On Xbee Module;
Establish Connection;
Power Off RF;
Enable Xbee Interrupt;
Disable RF Interrupt;
Return from Interrupt;

Algorithm 3: Xbee ISR

Read Data From Xbee Buffer;
if *Data corresponds to Clear Diagnostic Mode* **then**
    Clear Diagnostic Mode Flag;
else if *Data corresponds to Diagnostic Mode* **then**
    Set Diagnostic Mode Flag;
else if *Data corresponds to Retrieval Mode* **then**
    Set Retrieval Mode Flag;
else if *Data corresponds to Samplng Mode* **then**
    Set Sampling Mode Flag
else if *Data corresponds to Status Mode* **then**
    Set Status Mode Flag;
else if *Data corresponds to Shutdown Mode* **then**
    Set Shutdown Mode Flag;
Modify LPM bit in stack stored SR to take the CPU into Active Mode;
Return from Interrupt;

Algorithm 4: Diagnostic Event Service

Power Up All Components;
repeat
    Take measurement from Accelerometer;
    Take measurement from Gyroscope;
    Take measurement from Magnetometer;
    Get location from GPS;
    Get file system information from SD Card;
    Get Light Sensor Output;
    Toggle LED;
    Get measurement from Power Meter;
    Get Xbee Module Signal;
    Send Measurements to Base Station;
until *Diagnostic Flag Cleared*;
Return;

Algorithm 5: Retrieval Event Service

Get file system information from SD Card;
Send file system information to base station;
Send all data to base station;
Erase data from SD Card Return;

Algorithm 6: Sampling Event Service
Activate Xbee Module Low Power Mode;
Power on Accelerometer;
Power on Gyroscope;
Power on Magnetometer;
Clear Sampling Mode Flag;
Set Sampling Mode Timer;
while *SamplingTimeOver Flag Cleared* **do**
Set Sampling Frequency Timer;
Clear Sample Frequency Flag;
Get Accelerometer measurement;
Get Gyroscope measurement;
Get Magnetometer measurement;
Get Timestamp;
Write to SD Card;
while *SampleFrequencyFlag Cleared AND SamplingTimeOver Flag Cleared* **do**
Do Nothing;
end
end
Power Down Accelerometer;
Power Down Gyroscope;
Power Down Magnetometer;
Return;

Algorithm 7: Sampling Mode Timer ISR
Set Sampling Mode Flag;
Return from Interrupt;

Algorithm 8: Sampling Frequency Time ISR
Set Sampling Frequency Flag;
Return from Interrupt´

Algorithm 9: Location Event Service

Power On GPS;
Power On Xbee;
Enable Light Sensor Interrupt;
Establish Zigbee Connection;
repeat
    Get GPS Location;
    Send Location Data;
until *Sampling/Location is Cleared*;
Shut Down GPS;
Turn Off LED;
Return;

Algorithm 10: Light Sensor ISR

Turn On LED;
Disable Light Sensor Interrupt;
Return from Interrupt;

Algorithm 11: Status Event Service

Sync System Time;
Get SD Free Space Information;
Send SD Free Space Information To Base Station;
Get Battery Level;
Send Battery Level;

Appendices