

## PebbleDream Technical Document

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### What is the structure of the messages that are sent from the user interface to the middleware? give examples

Message sent from Pebble Watch to cell phone is in the form of a key-value pair. In our case, key is always '0'. And we simply copy the value as part of url and forward it from cell phone to server (middleware).

For example, if I want to query lowest Temperature so far, Pebble watch would send {'0': 'lowTemp'} to cell phone, who would in turns forward it as an XMLHttpRequest to server with URL 'http://[server\_ip:port]/lowTemp'. We make the lowTemp as a passed-in function parameter, so we can minimize the work lies on the JavaScript side.

### What is the structure of the messages that are sent from the middleware to the user interface? give examples

To simplify the process, all messages sent by server are in their final format. (what we send over air is what we will display on Pebble Watch screen, so no extra work would be done on Pebble watch side.)

The format of messages sent is in the format of JSON. e.g. {'msg': 'some text here'}. Again, to make things easier, we always use 'msg' as the key.

Though we have one exception. For temperature history, what we send over air is ten doubles, separated by commas. e.g. {'msg': '12.3,12.5,...,22.2,12.2,'}

Extra work need to be done on Pebble Watch side to figure out how to draw the line chart for temperature history.

### What is the structure of the messages that are sent from the middleware to the sensor/display? give examples

For the fundamental function, the middleware will send a single char to sensor/display.

'c' - will make the temperature on seven-segment display in Celsius;

'f' - will make the temperature on seven-segment display in Fahrenheit;

's' - will stop the sensor from sending current temperature to the server;

'r' - will resume reporting readings.

For the additional function, the middleware will send a string to sensor/display with prefix "tmp" or "stk".

"stk....." - will make it display the price of stock and the corresponding light. The string starts with "stk", then a digit of '+' or '-' indicating whether the price is increasing or decreasing and the rest being the price of the stock.

For example, "stk+123.45" means the price of stock is \$123.45 and it's increasing.

So the display will show the price 123.45 with GREEN light on. "stk-321.87" means the price of stock is \$321.87 and it's decreasing. So the display will show the price 321.87 with RED light on.

"tmp....." - will make it display the temperature forecast. The string starts with "tmp" and followed by the temperature with the last digit being 'c' or 'f' indicating whether it is in Celsius or in Fahrenheit. For example, "tmp23.45c" means temperature forecast is 23.45°C So the display will show 23.45 with a char 'c' at the end. "tmp75.12f" means temperature forecast is 23.45°F. So the display will show 75.12 with a char 'f'

at the end.

**What is the structure of the messages that are sent from the sensor/display to the middleware? give examples**

The messages sent from the sensor to the middleware will always represent temperature in Celsius for consistency and convenience. To make sure the server receives the complete message, the temperature will be bracketed inside a prefix 'S' indicating start and a postfix 'E' indicating end. For example, the temperature 26.625°C will be sent as S27.625E.

**How did you keep track of the average temperature? describe your algorithm and indicate which part of your code implements this feature**

The server stores the temperature information in a vector of SensorData object, which records both the temperature and the time when the temperature is recorded. When a request asking for the average temperature arrives, the server calls the function `getAverage` (line 296 `server.cpp`). This function adds up the temperature in the last hour and divide the sum by 3600 to get the average temperature. If the size of the vector is less than 3600, the function will add up the temperature for just the temperature records in the vector and divide it by the size of the vector.

**What are the three additional features that you implemented? indicate which parts of your code implement these features**

Display line chart over temperature history in the last minute on Pebble Watch → Server send history data, Pebble Watch parse it and display the graph/

Query Philly weather report, display information on Pebble Watch and show it on Arduino → Pebble watch send the query request to cell phone, cell phone query it and have results send to both Pebble Watch and server. Server would then forward the result to Arduino.

Query Yahoo! stock price, display stock price on Pebble Watch and show price on Arduino (Also, we use red light to indicate price decrease, green light to indicate price increase.) → Pebble watch send the query request to cell phone, cell phone query it and have results send to both Pebble Watch and server. Server would then forward the result to Arduino.

### **Pebble Watch**

Pebble watch User Interface contains mainly two parts:

1. A feature-selection menu
2. A graphical layer for displaying query result and show temperature line charts

For basic Arduino-based feature, Pebble Watch just send a query string as part of URL to server, and sever would send back messages back to Pebble Watch. So basically Pebble Watch just display result on the screen, plus some error handling (e.g. not sending successfully, message drop, etc.)

For additional features query weather + query stock price, Pebble Watch would send a request to cell phone, and cell phone serves as another middleware, which would in turns do the actual query, get the result and send to both Pebble Watch and server.

For additional features draw line chart over the last minute temperature, it is implemented as follows:

1. Pebble Watch asks for 10 number of last minute from server
2. Server send back the message contains the 10 number

3. Pebble Watch convert the string message into ten double number
4. Determine the min and max number in these 10 number, so we can decide how to draw the ten points and edges properly (e.g. draw the min number at the bottom of screen, draw the max number at the top of screen). We also need to know the screen size.
5. Draw ten points with radius on screen.
6. Connect the ten points

## 2. Server

The server.cpp main function opens two threads. The first thread getTem is responsible for reading temperature information, turning it into a SensorData object and storing it in a SensorData vector. It first creates a file descriptor for Arduino. If the connection is successful, it starts to read bytes from Arduino and append the bytes to a string message until a '\n' is read. Then the temperature information is retrieved and turned into a SensorData object, which records the temperature as well as the time when the temperature is read. The SensorData object is then added into a SensorData vector to keep track of the temperature history. Several functions are provided to calculate temperature statistics such as average temperature from the vector.

The second thread startServer opens the server and listens to request from some port specified by the command line. When a request arrives, the GET information is retrieved and corresponding response is sent to the client. If the request asks for temperature information, the server calls some functions to get the temperature statistics and respond with a JSON object. When the request asks to communicate with Arduino, such as displaying number on Arduino, changing the light color, the server sends the control message to Arduino through the write function.

## 3. Arduino

The sensor will send back to server the temperature in Celsius every second if no in stand-by mode. And listen to the message send back by server. If it is 'c', the mode for display will be set to Celsius (also the default mode). If it is 'f', it will be set to Fahrenheit. The temperature will be displayed with only one digit after decimal point but the temperature send back to server will be as accurate as it senses. The F to C conversion for display is done in the Arduino side. For the additional features, the main task for Arduino is to display every digit of the message send from Server. So the display need to be in a rolling mode, which means the current display will be shifted left by one digit after a certain interval