



## iHTM Software development with Vibration sensors

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## Vibration sensor data for Infusion Pump

### Summary of Tasks

1. Review and identify an Infusion pump similar to “Baxter Sigma Spectrum Infusion Pump”.
2. Research and recommend the vibration sensors that will be used with the Infusion Pump.
3. Research on what type of data/information can be possibly collected and develop scripts to access the data from the Infusion Pump via Wifi.
4. Develop APIs that will allow the data to be connected to the iHTM software that will be developed as a separate project.

### Features and Functions developed for Infusion Pump

SDI will spend time in R&D to identify & recommend the sensor's that best match with the infusion pump similar to the Baxter Sigma Spectrum Infusion Pump. The following types of Vibration sensors will be reviewed

1. **Strain Gauges** - A Strain gauge is a foil that's applied directly to the surface of the machine being monitored. The foil contains an electrically conductive grid. As the grid is stretched or compressed—such as when that piece of equipment is vibrating—it changes the electrical resistance of the grid. These readings can be used to measure the vibration of an object based on how much the material is “straining.”
2. **Accelerometers** - Accelerometers measure the changes of velocity of a given component. When attached to a piece of equipment, any vibration will reflect a change in velocity, which will cause the accelerometer to produce an electrical signal. That signal is then interpreted to produce vibration data.



3. **Eddy-Currents** - An Eddy-Current sensor is a non-contact sensor that produces magnetic fields which are used to measure the relative movement of a given object. If the sensor is fixed in place and the object is vibrating, that movement will register in the magnetic field.

4. **Laser displacement** - Laser displacement sensors are non-contact sensors, except instead of using magnetic fields and electric currents, they use a laser beam with triangulation. The beam is aimed at the asset and reflects back through a receiving lens into a receiving element. Any changes in the object's position will cause the beam to hit a different part of the receiving element.

5. **Microphone sensors** - Vibrations create sound, and that sound is often beyond the range of human hearing. Microphone sensors provide some basic information on changes that might occur in high-frequency vibrations that equipment operators wouldn't normally be able to detect.

## API Web Services i.e iConnect

SDI will develop API web-services endpoints (i.e iConnect) to collect and send data to Long Range Wide Area Network (LoRaWAN) gateways located on-site with the sensors. The local LoRaWAN gateway will relay data to a network server in the cloud that will handle the encryption and authentication of the data. The data are then passed from the LoRaWAN network server to the end application (iHTM Application)

SDI will develop the API for the following

- Monitor equipment status i.e Uptime & Downtime
- Monitor equipment health status
- Detect system errors
- Collect equipment usage & maintenance insights



## iHTM Software

### Summary of Tasks

1. SDI will use openMAINT (<https://www.openmaint.org/>) open source software to develop the iHTM software. Client will acquire the licence and provide to SDI
2. SDI will download, install & make the required changes in the configuration to run the Self-Service version of the openMAINT software on the Cloud Platform.
3. SDI will use the openMAINT software as is with all the features & functions that are available in the Self-Service version of the openMAINT software. SDI will not remove or modify features and/or functions from the openMAINT software.
4. SDI will customize only those functions of openMAINT that are required to read data from the sensors. These may include the following features below

### Features and Functions

1. Dashboard shall display equipment name and utilization rate.
  - Users will be able to see a list of equipment categories - **Infusion Pump, GPS tracker & Vibration Sensor devices**
  - Users will be able to see the amount of equipment on/utilized., idle and off.
  - Users will be able to see equipment utilization status in percentage.
2. Data shall be stored in a secured cloud based remote storage.
  - Equipment Inventory should be easily uploaded from Excel or Access to the software database.



- Access to the database shall be password protected.
- Database will be accessible via the internet.

### 3. Software will track maintenance records and schedules.

- Users will be able to store maintenance records (service done and service due).
- Users will be able to schedule service and send calendar reminders by email and SMS.

### 4. Compliance reports should be automatically generated from maintenance records.

- Users will be able to generate a compliance report.
- Reports will be generated by the software from the equipment records database. The report format will be generated as per the PDF file shared by the client. See Below

#### Regulatory Compliance Monthly Report - 2018

Report Description: This report encapsulates all of the information required for regulatory compliance and also active inventory, cost spent on work orders for use error and/or equipment abuse.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
<b>High Risk</b>													
PM WO Opened	137	137	22	128	81	38	171	152	25	115	66		1072
PM WO Compliant Within Time	134	128	21	127	81	38	171	152	25	114	0		991
PM WO Compliant Within Time %	97.8%	93.4%	95.5%	99.2%	100.0%	100.0%	100.0%	100.0%	100.0%	99.1%	0.0%		92.4%
PM WO Compliance Overall	137	136	22	128	81	38	171	152	25	114	0		1004
PM WO Compliance Overall %	100.0%	99.3%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	99.1%	0.0%		93.7%
Device in Use	0	0	0	0	0	0	2	0	0	0	0		2
Device in Use - %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.2%	0.0%	0.0%	0.0%	0.0%		0.2%
Unable to Locate	3	7	0	2	0	1	9	4	2	3	0		31
Unable to Locate - %	2.2%	5.1%	0.0%	1.6%	0.0%	2.6%	5.3%	2.6%	8.0%	2.6%	0.0%		2.9%
Vendor Service	0	0	1	0	0	0	0	0	0	1	0		2
Vendor Service - %	0.0%	0.0%	4.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.9%	0.0%		0.2%
PM Failure	1	0	0	0	0	2	8	2	0	1	0		14
PM Failure %	0.7%	0.0%	0.0%	0.0%	0.0%	5.3%	4.7%	1.3%	0.0%	0.9%	0.0%		1.3%



5. Utilization and location report will be automatically generated.

Users will be able to generate location report based on the GPS tracker historical data.

Users will be able to generate utilization report based on the vibration sensor historical data.

6. Vibration and location sensors should connect with the iConnect software via Wi-Fi..

- Software will use a secure interface (iConnect) to connect with the remote sensors.
- Connection with the sensors will be secure, clear, strong and error free most of the time.

## Interface Requirements

1. User Interfaces - The system will have a portal for the users to input their user's name and password in order to gain full access to the software. The interface will be able to handle multiple users at the same time and **will also be able to give different levels of access to different users based on the program administrator permission.** **Note: This function in RED will be available only if the client purchases the Subscription version of the openMAINT software.**

2. Software Interfaces - The software interface for this program will be determined by the software developer and will include databases, forms and reports for the users to query and organize data to suit their needs. Forms and reports both will be built in a way so that they let users specify which fields they want to use and which constraints they want to define. **Note: SDI will not customize the Software Interface. It will be the same interface that comes with openMAINT software**



3. Hardware Interfaces - The database will be stored in a remote hard drive (server) and will be managed by the remote operating system. Software program will enable users to access the data from the host server.
4. Communications Interfaces - The program will use an interface i.e iConnect to communicate with the sensors. The iConnect interface will handle connections with the GPS and vibration sensors.

Investment cost & delivery timelines

Phase 1 - Vibration sensors for infusion pump

Tasks	Duration	Cost
<b>Milestone 1 - 1st Month</b> <b>Main Task</b> - Research & Identify at least 3 IoT vibration sensor device(s) <b>Supplementary tasks</b> - Connect & Configure the vibration sensor device(s) - Identify Acceleration measurement - Identify Dynamic range +/- 4G (configurable to 2, 4, 8 or 16) - Identify Frequency range 10-1000Hz - Identify Sampling rate 6600Hz	1 Month	\$3933
<b>Milestone 2 - 2nd Month</b> <b>Main Task</b> - Analyze & Understand the Signal processing circuitry and the digital vibration signal data i.e Intensity & Frequency data to determine its accuracy in identifying any imbalances or other issues in the equipment	1 Month	\$3933
<b>Milestone 3 - 3rd Month</b> - Connect the IoT vibration sensor device to an IoT Gateway. - Create an API to transfer the vibration signal data from & to the Cloud DB . - Create a simple one screen Web UI to display the stored data in structured format for analysis.	1 Month	\$3933
Total	3 months	\$11799





**Payment Terms for Phase 1**

- Upfront payment upon contract submission - **\$3933**
- Payment due at the start of the 2nd Month - **\$3933**
- Payment due at the start of the 3rd Month - **\$3933**

Client will acquire the Infusion Pump & Vibration sensors & ship/send to our India Dev center.

**Phase 2 - iHTM Software - To be decided later**

Task Details	Duration	Cost
iHTM software - Setup, configure and integrate open source software (OpenMaint) as is and customizing/developing functions listed on page 5,6,7	4 months	\$23780

**Payment Terms for Phase 2**

- 50% upfront
- 50% on completion prior to final delivery



## Source Codes and IP ownership

All of the project Source codes will be handed over to the client on project completion. Upon completion and payment of all agreed invoices to SDI, the Client will be the sole and exclusive owner of the website and own IP - Intellectual property of the project.