

DESIGN AND IMPLEMENTATION OF HETEROGENEOUS SENSOR-BASED EMBEDDED SYSTEM FOR FLOOD MANAGEMENT

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- under the guidance of **Prof. D. P. Acharya**

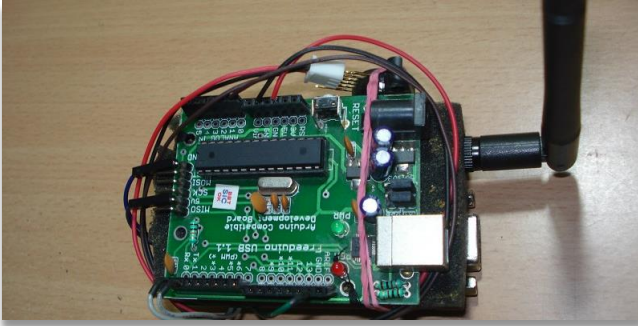


OBJECTIVE

- To design and implement a **modern, internet-based** flood management system, that is **simple, cost effective, easy to deploy and use.**



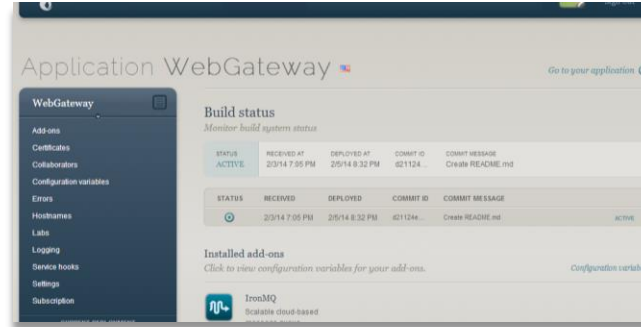
PROJECT OUTPUT



Heterogeneous Sensor Module

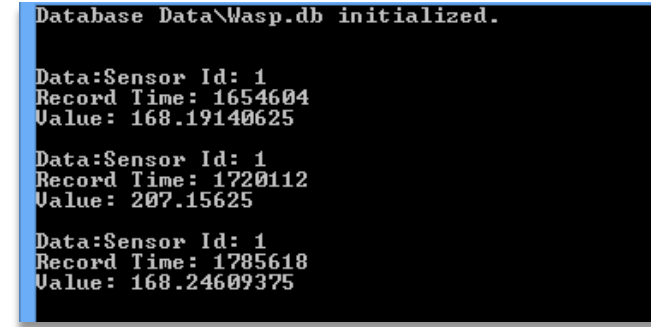
Wireless Sensor Module –
(ATmega328, FLY900)

Firmware –
(C++, Arduino)



Cloud-based Gateway

Cloud Server Software –
(C#, ASP.NET)



Local Host Storage Module

Local Host Software –
(C#, SQLite)



FEATURES

- **Low Power – 20mW**
- **Low unit cost - ₹ 3000**
- **Low usage cost - ₹ 20 / month**
- **Compact and Portable**
- **Easily Scalable**
- **Simple to use**

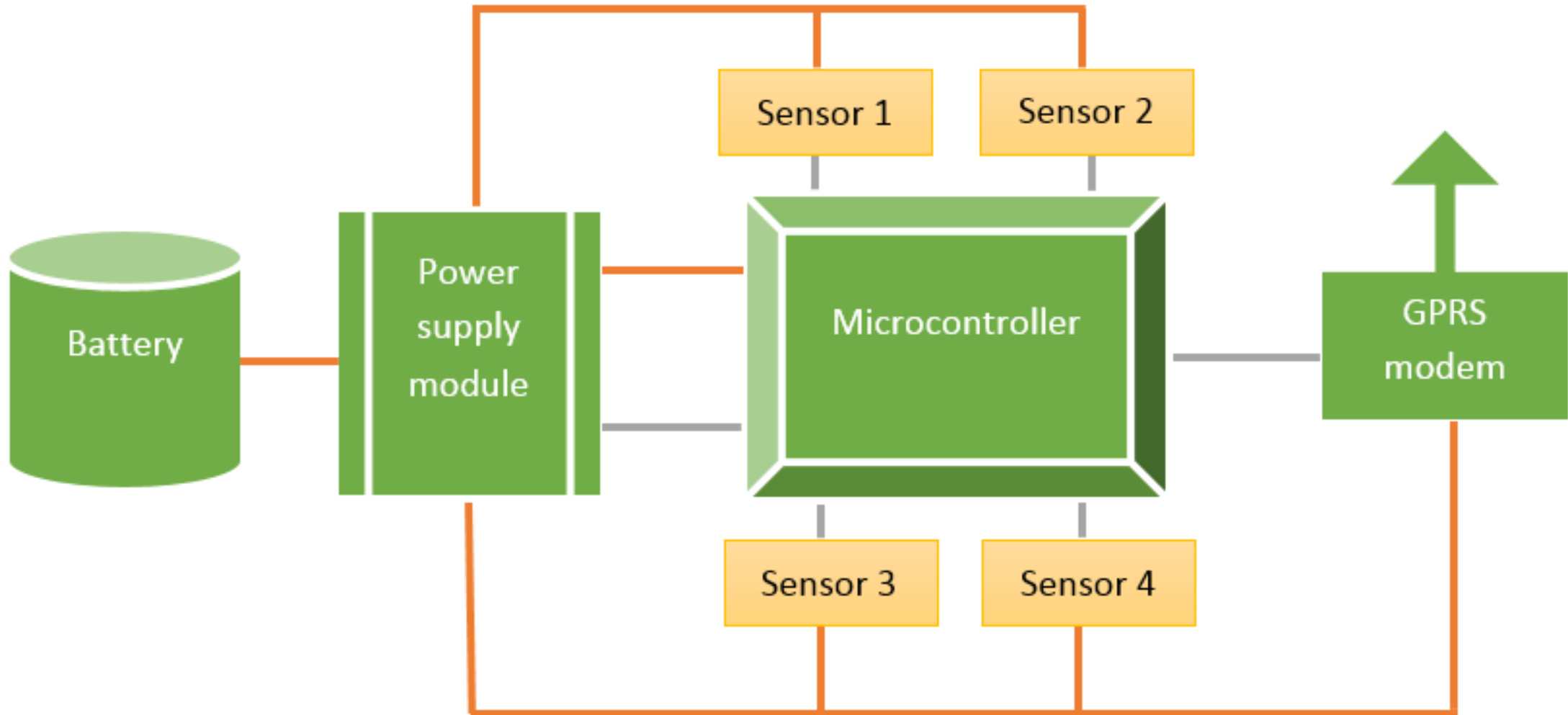


PROJECT DESCRIPTION

- Hardware Architecture
- Software Architecture
- System Data Flow
- System on Single PCB



HARDWARE ARCHITECTURE

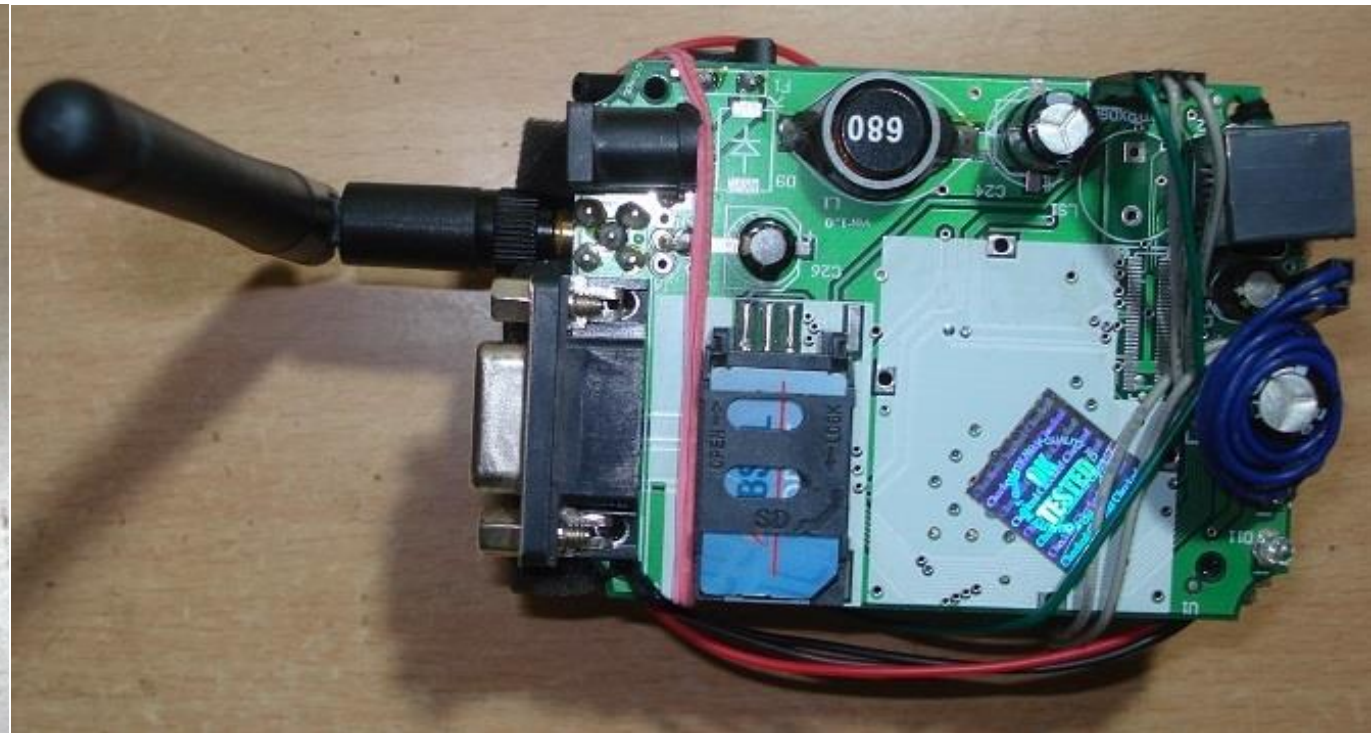


HARDWARE: IMPLEMENTATION

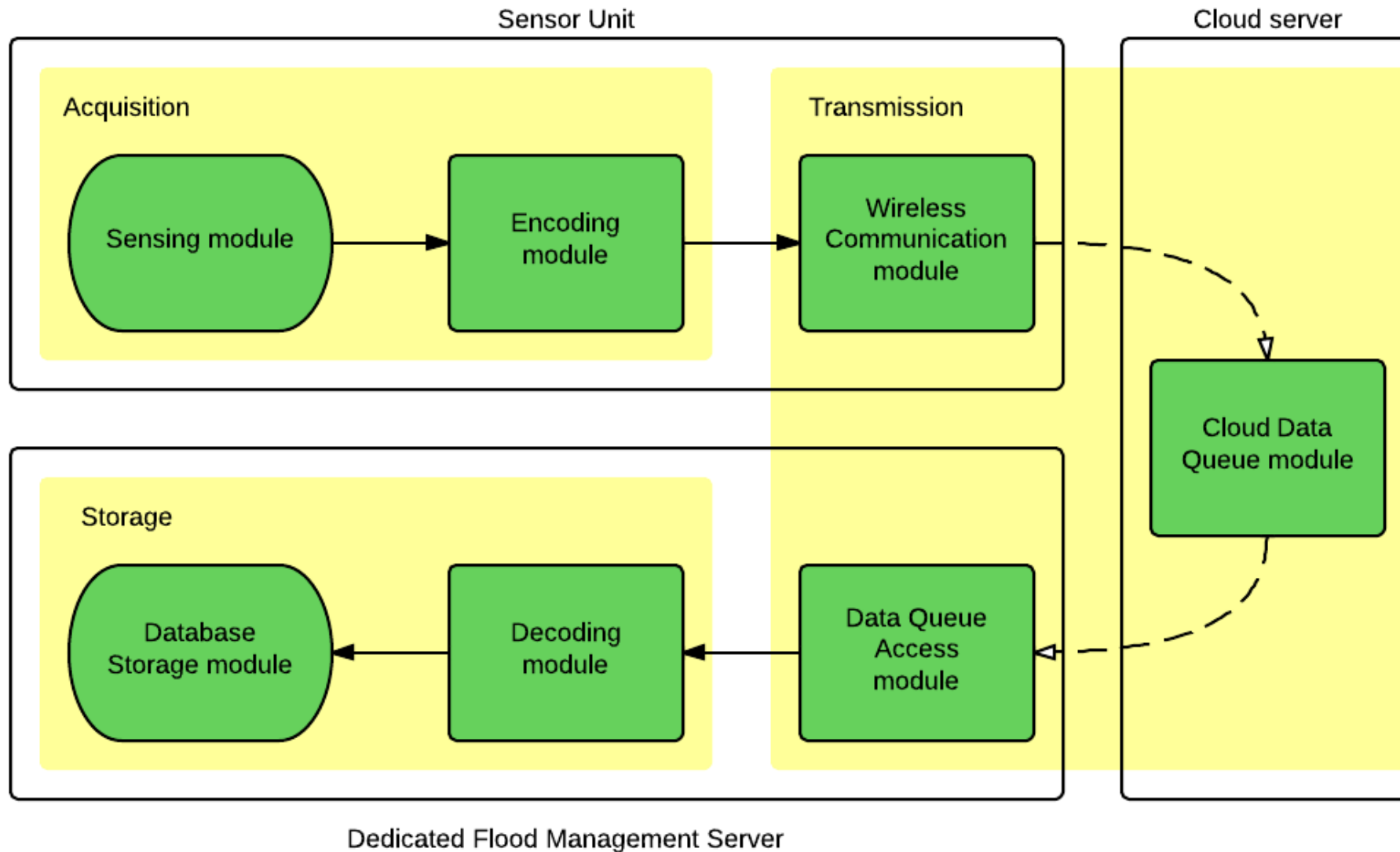
Microcontroller Side



Wireless GSM & GPRS Side

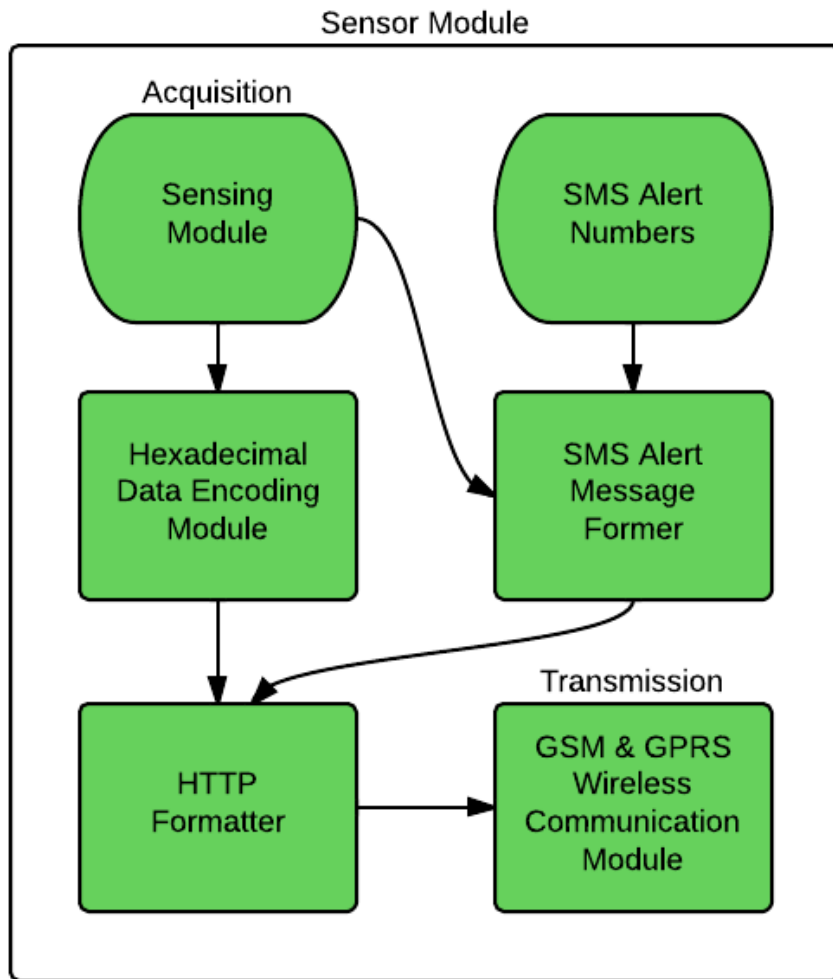


SOFTWARE ARCHITECTURE

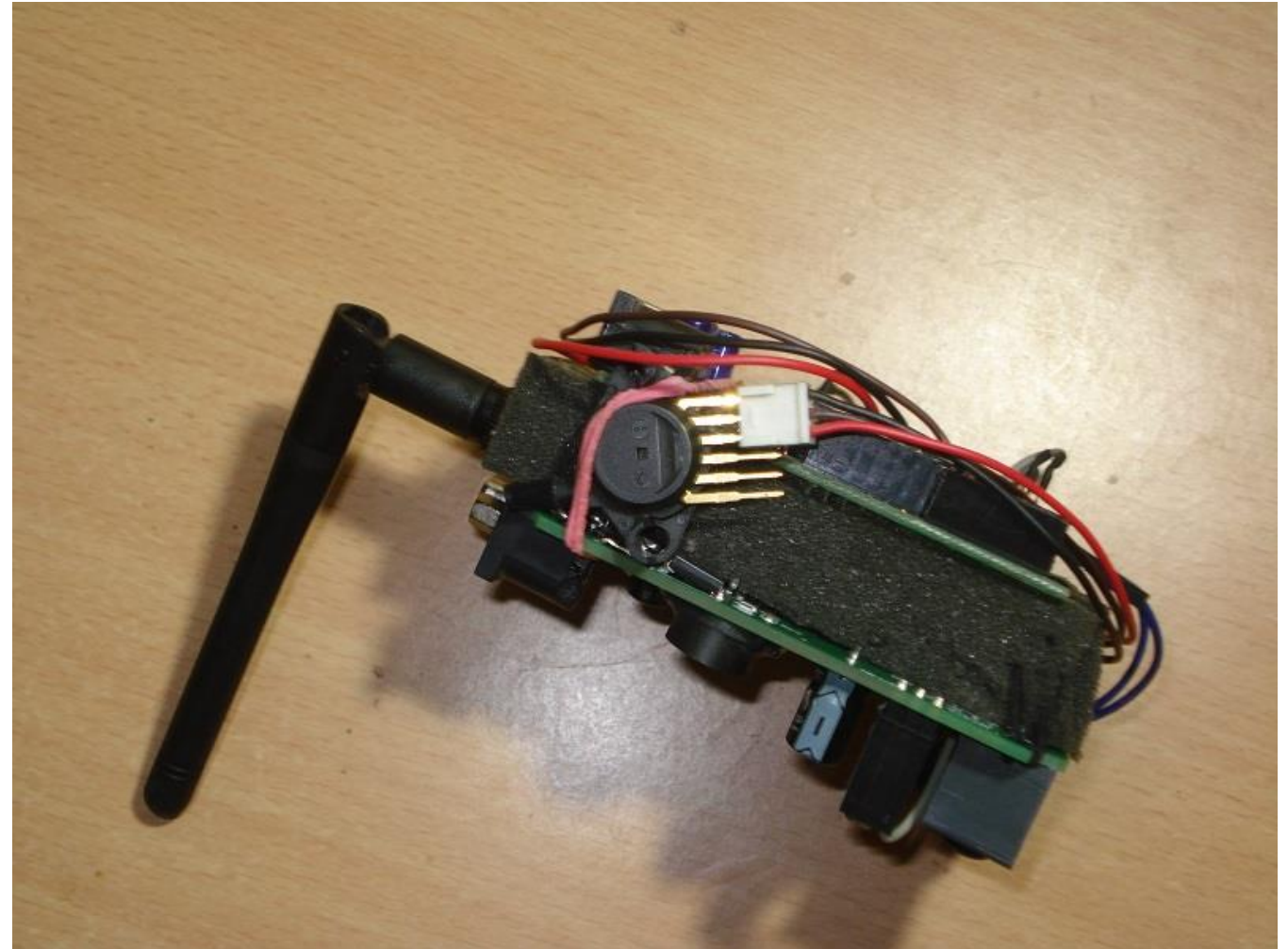


DATA FLOW: ORIGIN

Block Diagram

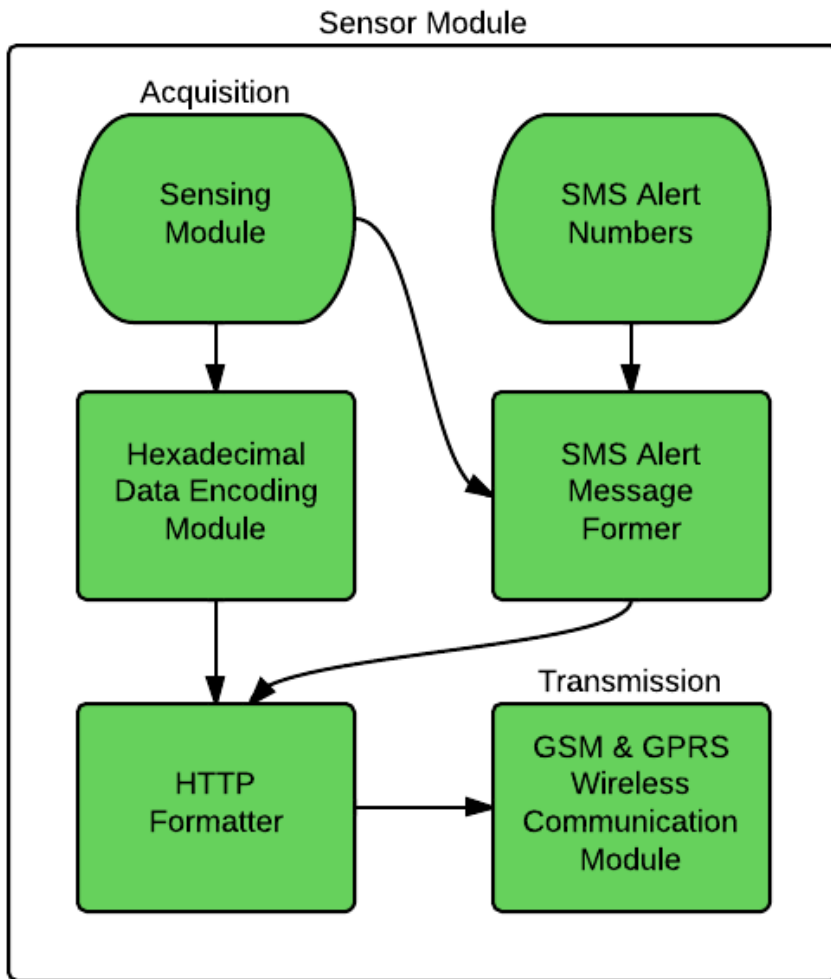


Operation



DATA FLOW: ENCODING AND FORMATTING

Block Diagram



Operation

way - WASP x Documents x Data Flow Architecture: Lu x

webgateway.apphb.com

Captured Data

01000000CFB2050000D45C43. ← One Packet (in hex, 12 bytes)

01000000B29D060000ED2A43.

010000009588070000B04943.

010000005B5E09000051A043.

010000003D490A0080C597.

0100000020340B0000F39E.

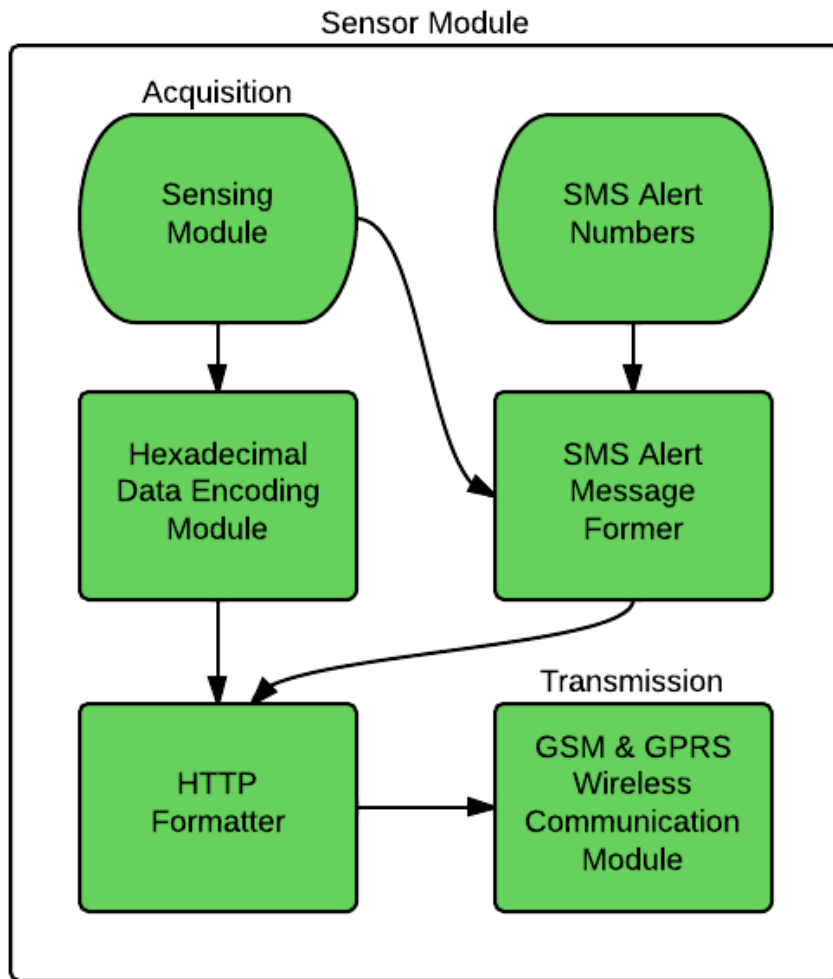
01000000031F0C0000A29F.

010000005B5E09000051A043.

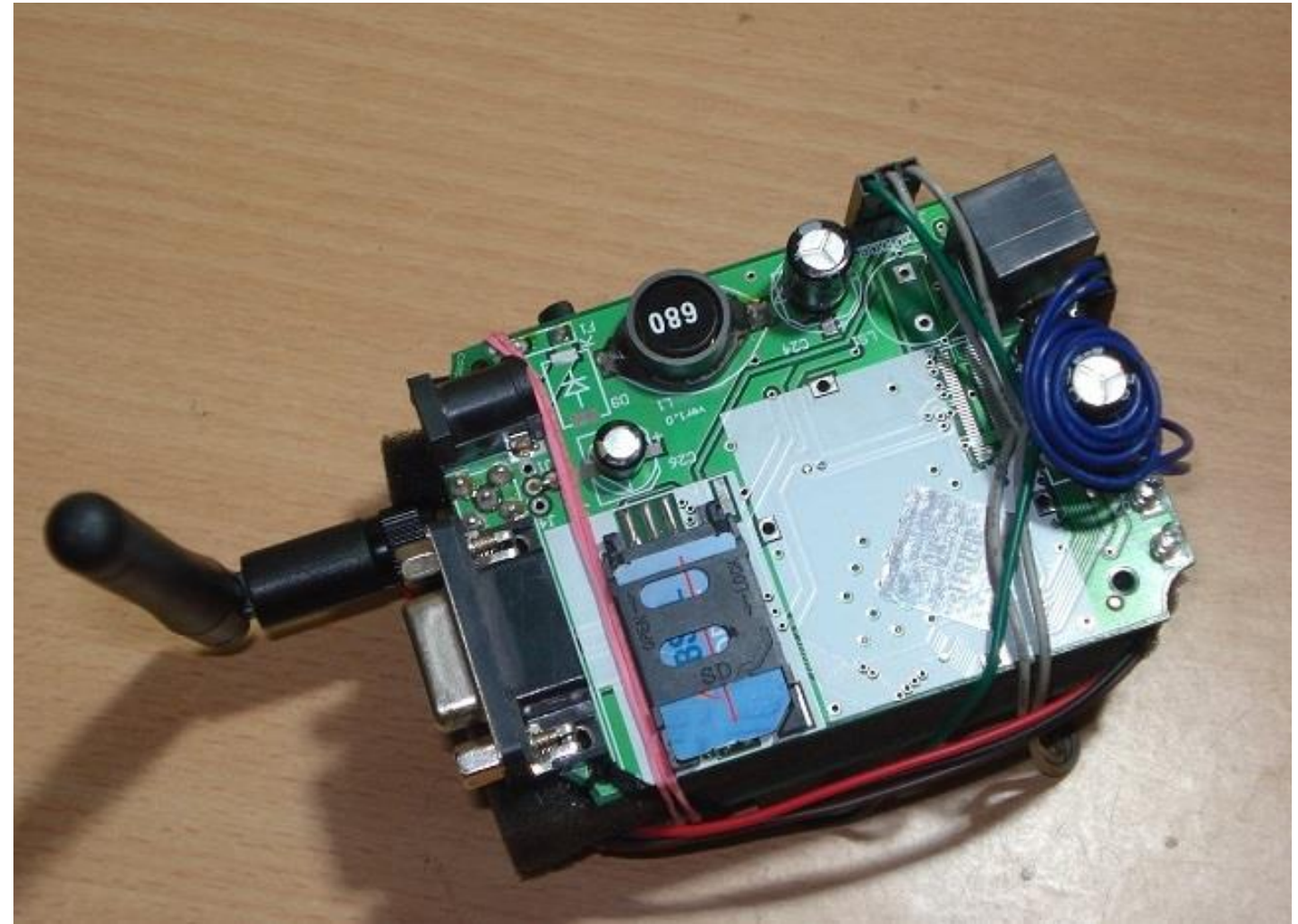
GET <Cloud server URL> HTTP/1.1
Host: <Cloud server base URL>
User-Agent: wasp([hex])
Connection: close

DATA FLOW: WIRELESS TRANSMISSION

Block Diagram

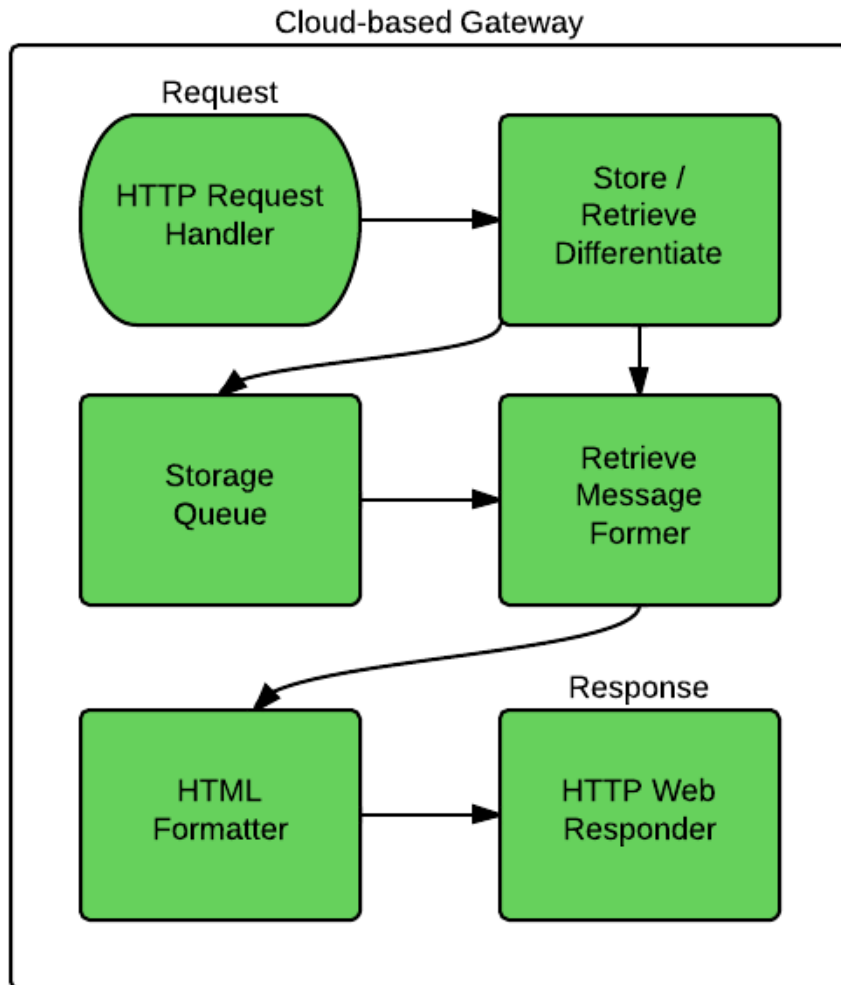


Operation



DATA FLOW: INTERMEDIATE GATEWAY

Block Diagram



Operation

The screenshot shows the AppHarbor Application WebGateway interface. The top navigation bar includes links for **Your Applications**, **How It Works**, **Pricing**, **Add-ons**, and **Support**. The user **wolfram77** is logged in. The main heading is **Application WebGateway**. A sidebar on the left lists various settings: **Add-ons**, **Certificates**, **Collaborators**, **Configuration variables**, **Errors**, **Hosnames**, **Labs**, **Logging**, **Service hooks**, **Settings**, and **Subscription**. The **WebGateway** section is active, showing the **CURRENT DEPLOYMENT** with a commit ID of **d21124e...** deployed on **2/5/14 8:32 PM**.

The **Build status** section monitors the build system status. It displays two tables of build information:

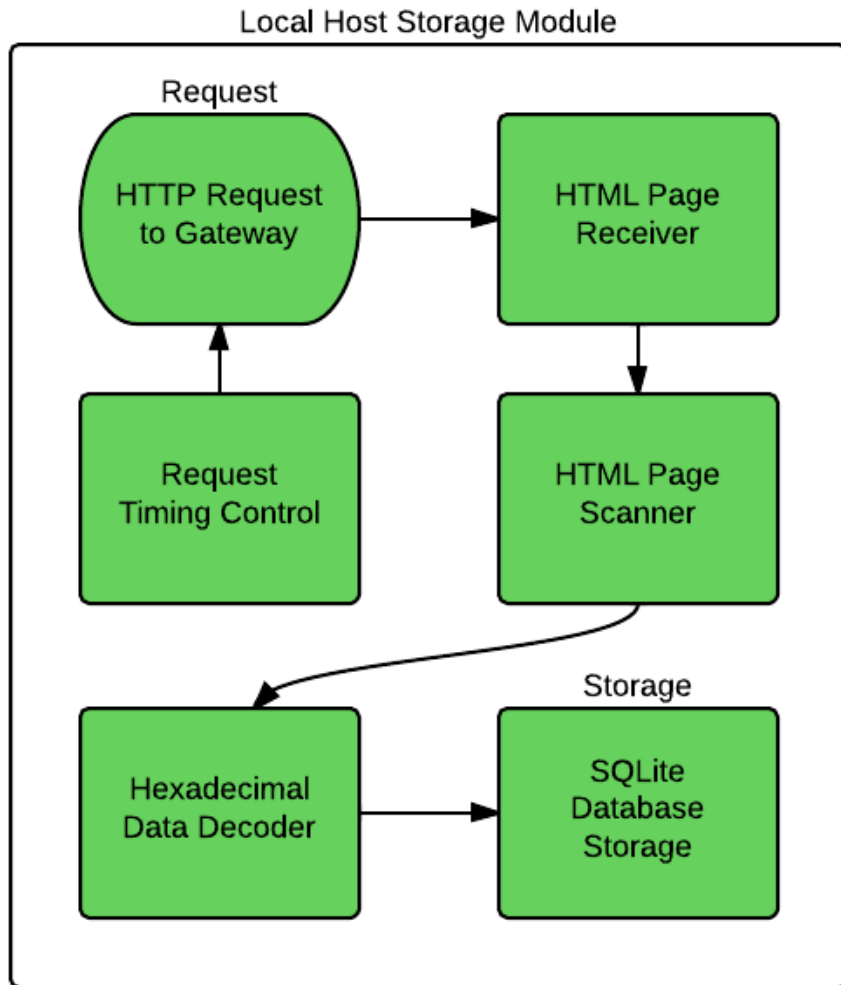
STATUS	RECEIVED AT	DEPLOYED AT	COMMIT ID	COMMIT MESSAGE
ACTIVE	2/3/14 7:05 PM	2/5/14 8:32 PM	d21124...	Create README.md

STATUS	RECEIVED	DEPLOYED	COMMIT ID	COMMIT MESSAGE	
ⓘ	2/3/14 7:05 PM	2/5/14 8:32 PM	d21124e...	Create README.md	ACTIVE

The **Installed add-ons** section shows the **IronMQ** add-on, described as a **Scalable cloud-based message queue**. A link for **Configuration variables** is also present.

DATA FLOW: RETRIEVAL FROM GATEWAY

Block Diagram



Operation

```
file:///C:/Home/Develop/WASP/App/Server/UhuruCI
Database Data\Wasp.db initialized.

Data:Sensor Id: 1
Record Time: 1654604
Value: 168.19140625

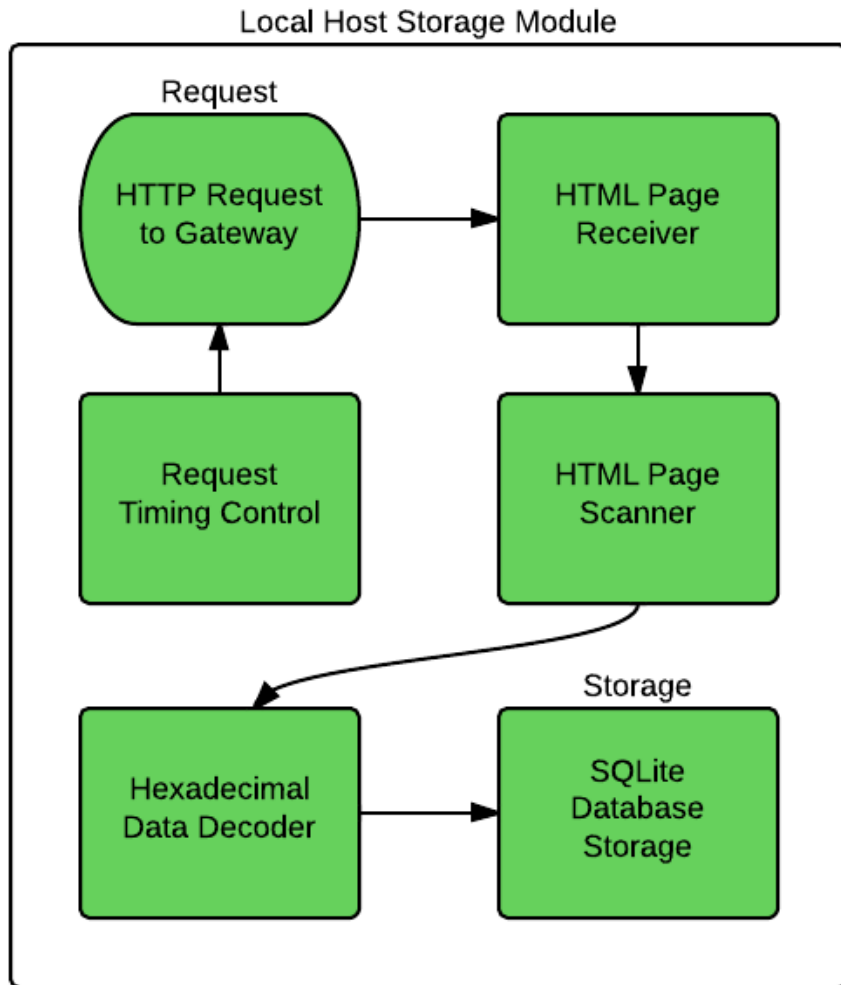
Data:Sensor Id: 1
Record Time: 1720112
Value: 207.15625

Data:Sensor Id: 1
Record Time: 1785618
Value: 168.24609375
```



DATA FLOW: STORAGE TO DATABASE

Block Diagram



Operation

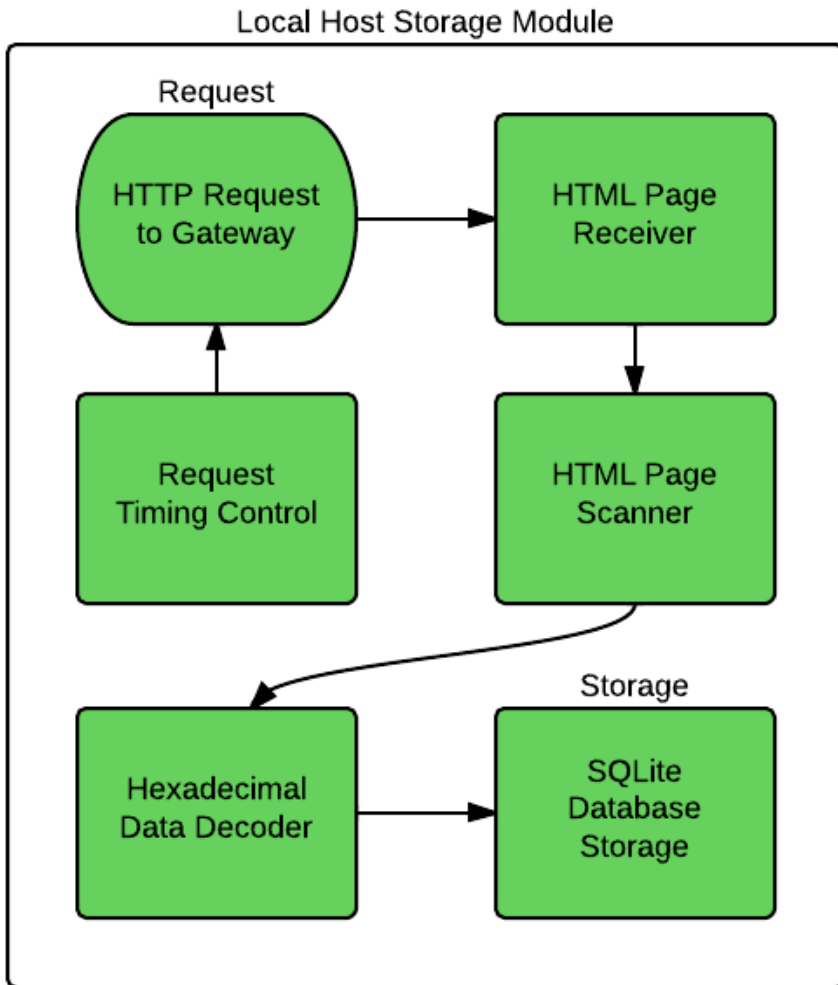
The screenshot shows the SQLite database interface. On the left, the database 'Wasp.db (SQLite 3)' is open, and the 'Temp' table is selected. The table structure is shown as follows:

#	Id	Time	Value
1	1	30	102.345
2	1	60	103.124
3	1	90	104.738
4	1	120	102.746
5	1	150	104.534
6	1	180	103.758
7	1	210	103.856



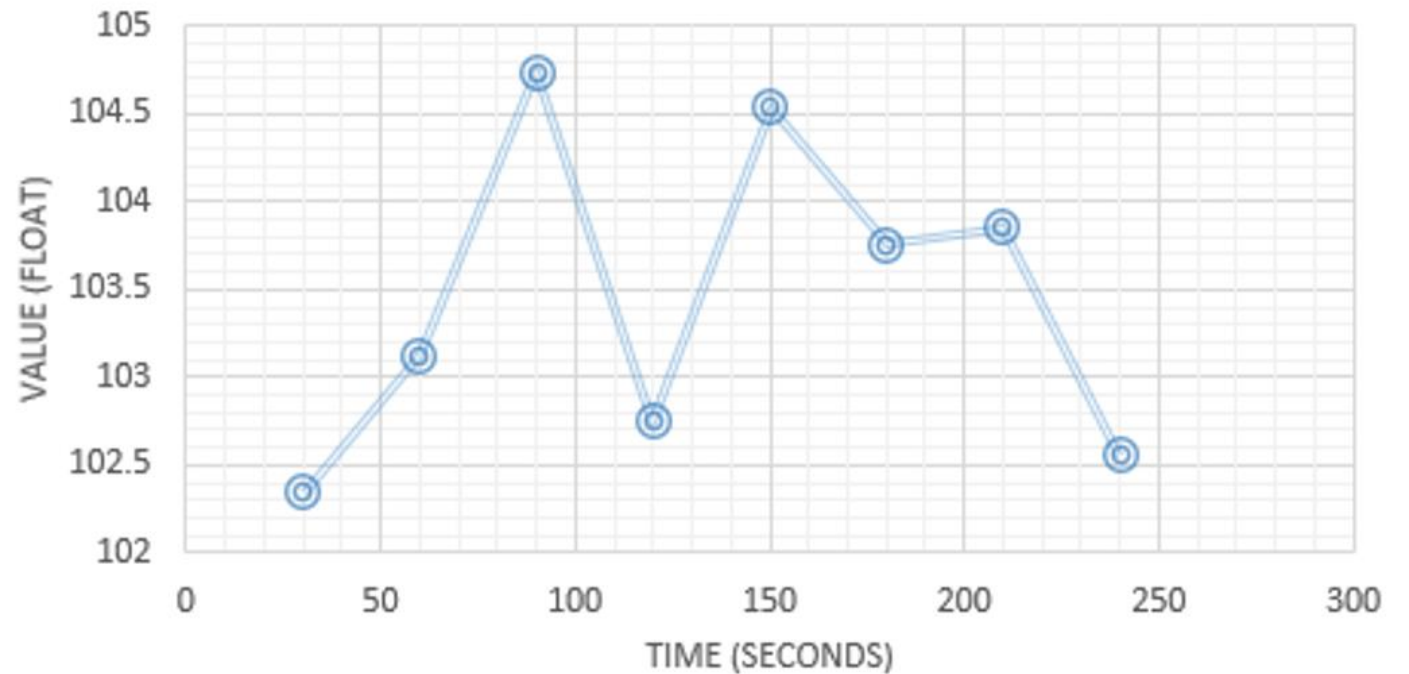
DATA FLOW: DATA VISUALIZATION

Block Diagram



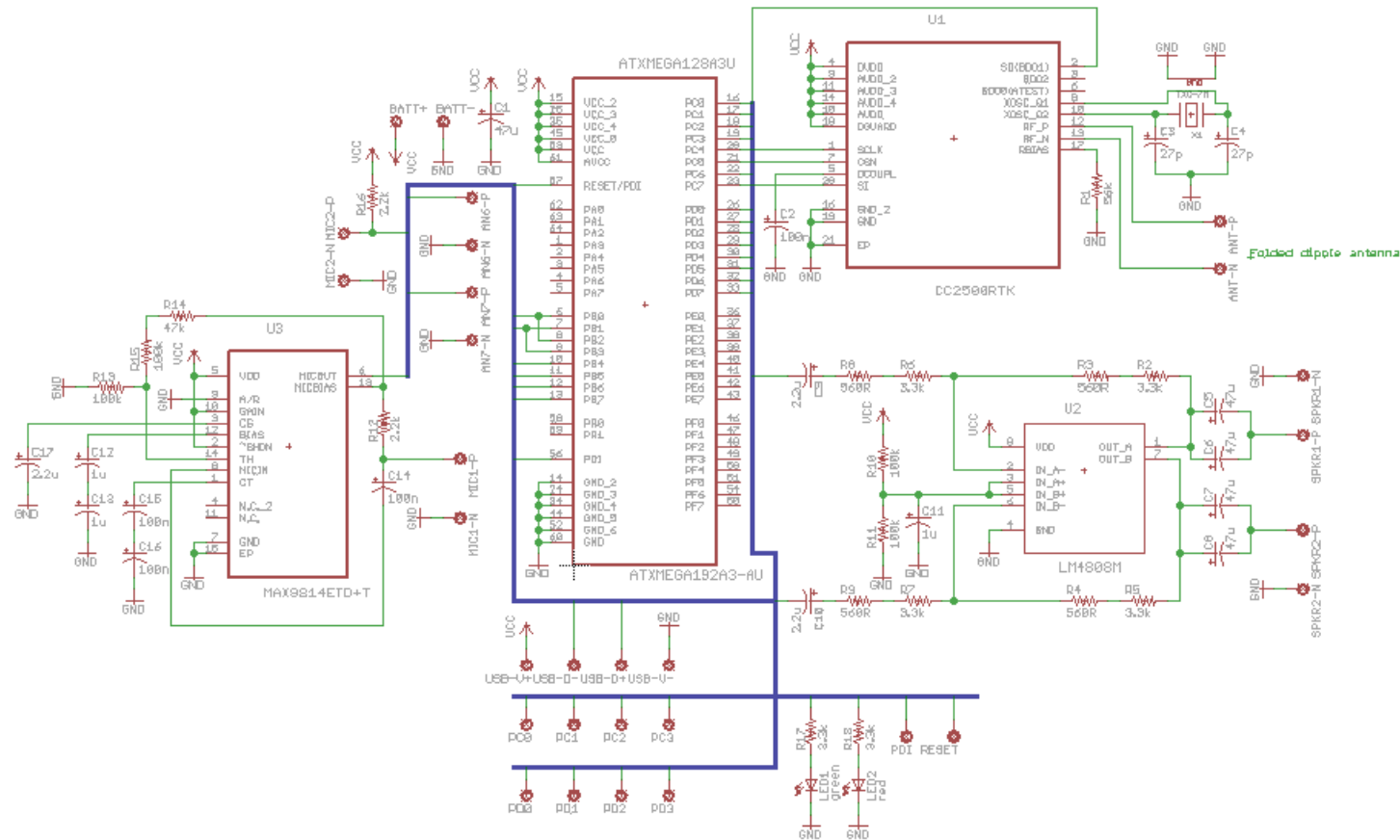
Operation

Captured Data from Sensor unit

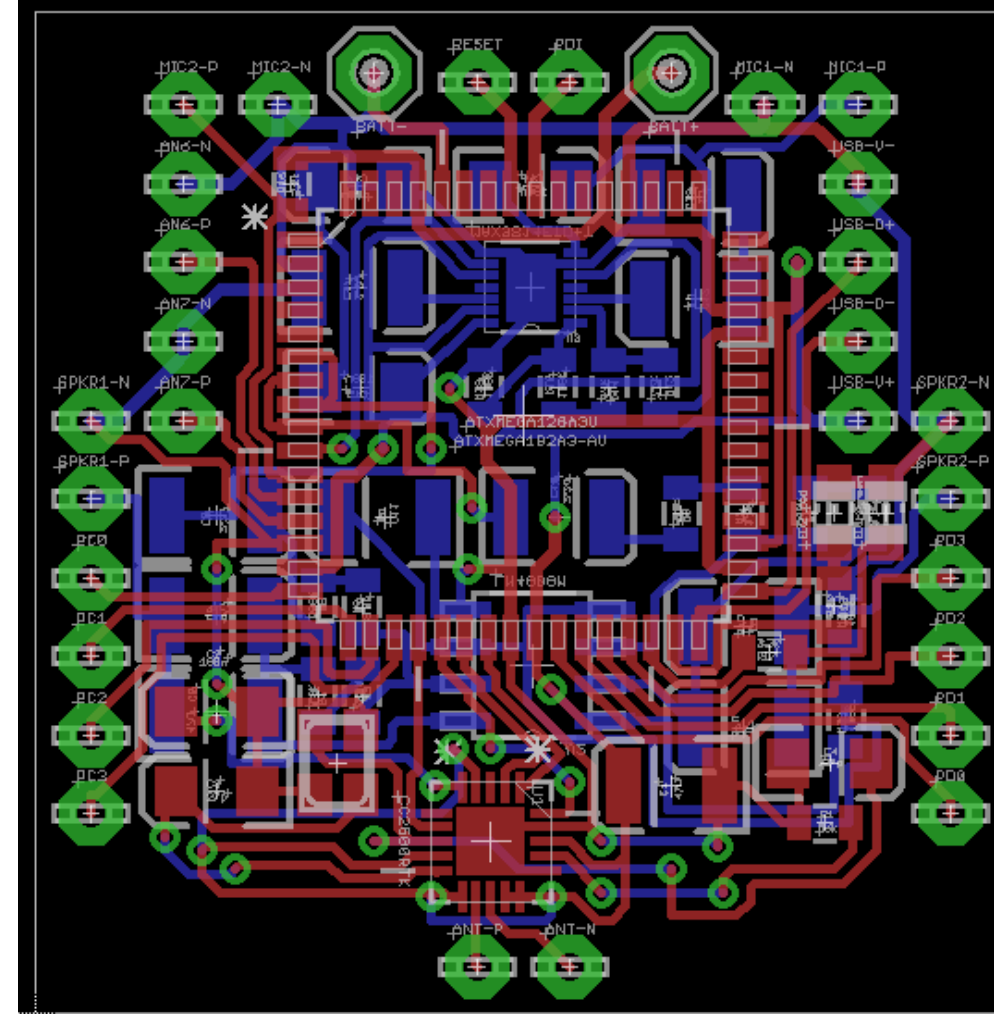


SYSTEM ON SINGLE PCB: DESIGN

Schematic Design

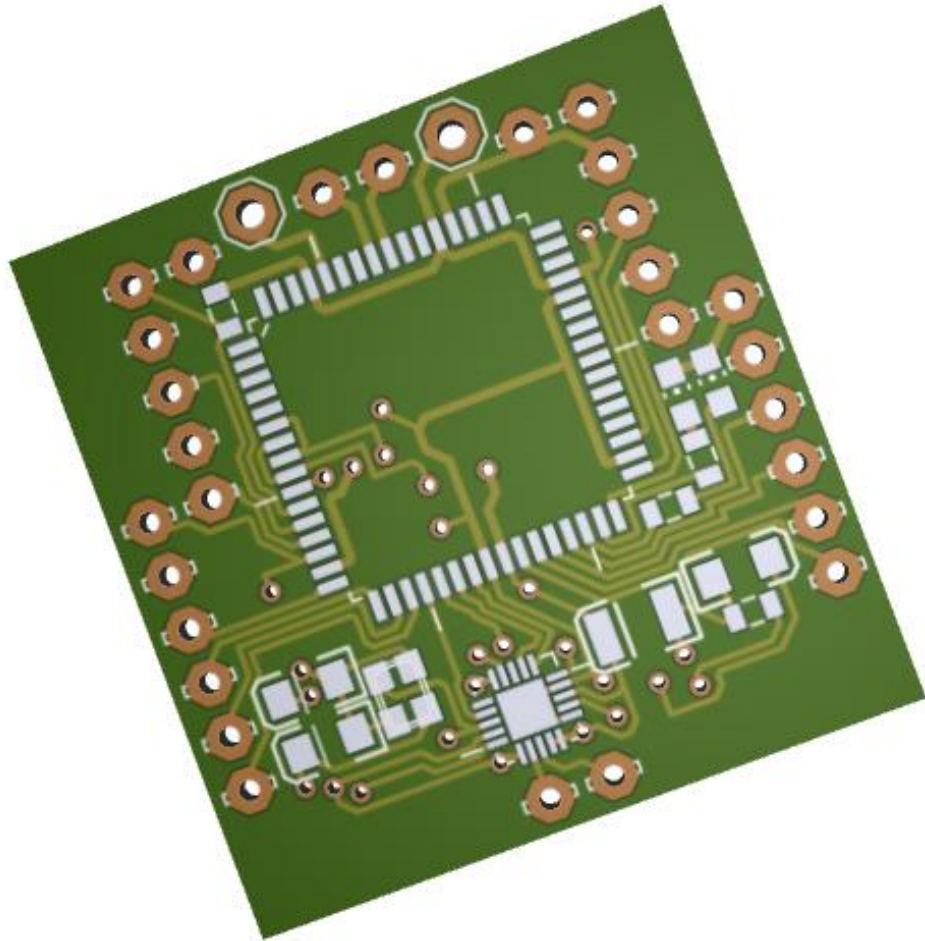


PC Board Layout

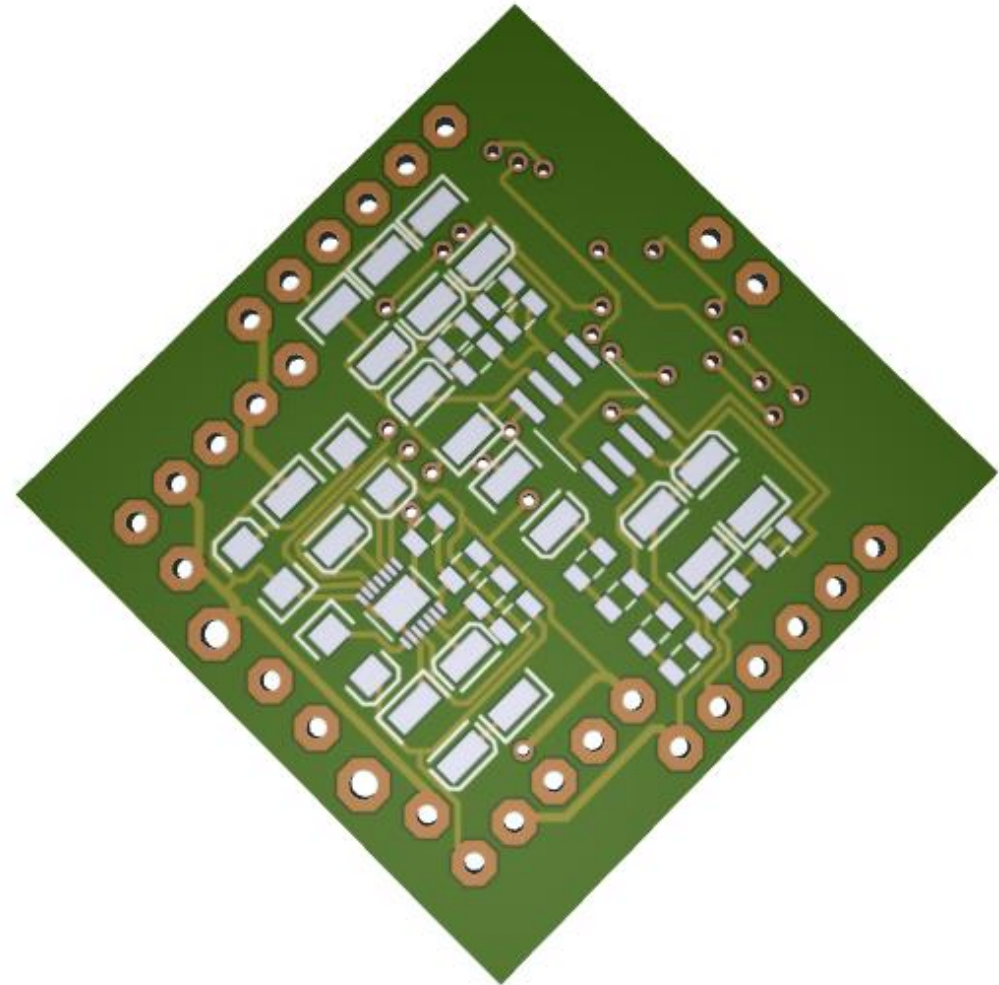


SYSTEM ON SINGLE PCB: DESIGN

Component Side - Gerber 3D



Solder Side - Gerber 3D

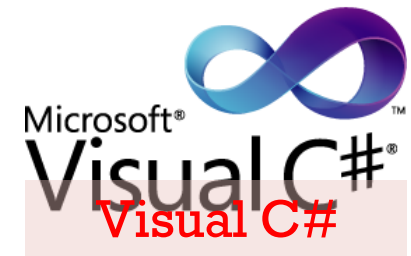


SOFTWARE / IDES USED

Heterogeneous Sensor Module



Cloud-based Gateway



SOFTWARE / IDES USED

Local Host Storage Module



Data Searching and Usage



CONCLUSION

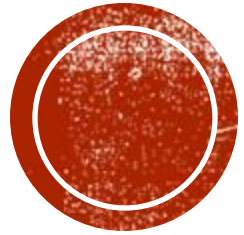
- An **internet-based** heterogeneous-sensor **flood management system** was developed that **measures a parameter** (air pressure) and delivers it **wirelessly, wherever desired** (office).



MAJOR REFERENCES

- Xiang Yang Li, K. W. Chau, Chun Tian Cheng, Y. S. Li. A Web-based flood forecasting system for Shuangpai region. *Advances in Engineering Software* 37 (2006), 146-158.
- Bartosz Balis, Marek Kasztelnik, Marian Bubak, Tomasz Bartynski, Tomasz Gubala, Piotr Nowakowski, Jeroen Broekhuijsen. The UrbanFlood Common Information Space for Early Warning Systems. *International Conference on Computational Science, ICCS 2011*.
- Ibrahim Demir, Witold F. Krajewski. Towards an Integrated Flood Information System: Centralized data access, analysis, and visualization. *Environmental Modeling & Software* 50 (2013), 77-84.
- V.V. Krzhizhanovskaya, G.S. Shirshov, N.B. Melnikova, R.G. Belleman, F.I. Rusadi, B.J. Broekhuijsen, B.P. Gouldby, J. Lhomme, B. Balis, M. Bubak, A.L. Pyayt, I.I. Mokhov, A.V. Ozhigin, B. Lang, R.J. Meijer. Flood early warning system: design, implementation and computational modules. *International Conference on Computational Science, ICCS 2011*.
- W. Al-Sabhan, M. Mulligan, G.A. Blackburn. A real-time hydrological model for flood prediction using GIS and the WWW. *Computers, Environment and Urban Systems* 27 (2003), 9-32.





THANK YOU

