

Modular Biometric Monitoring System

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Topics of Discussion

- Introduction to the project
- Hardware development & testing
- Software development & testing
- Conclusion

Introduction

- Background & Overview
- Project Summary
- Project Resources

Background

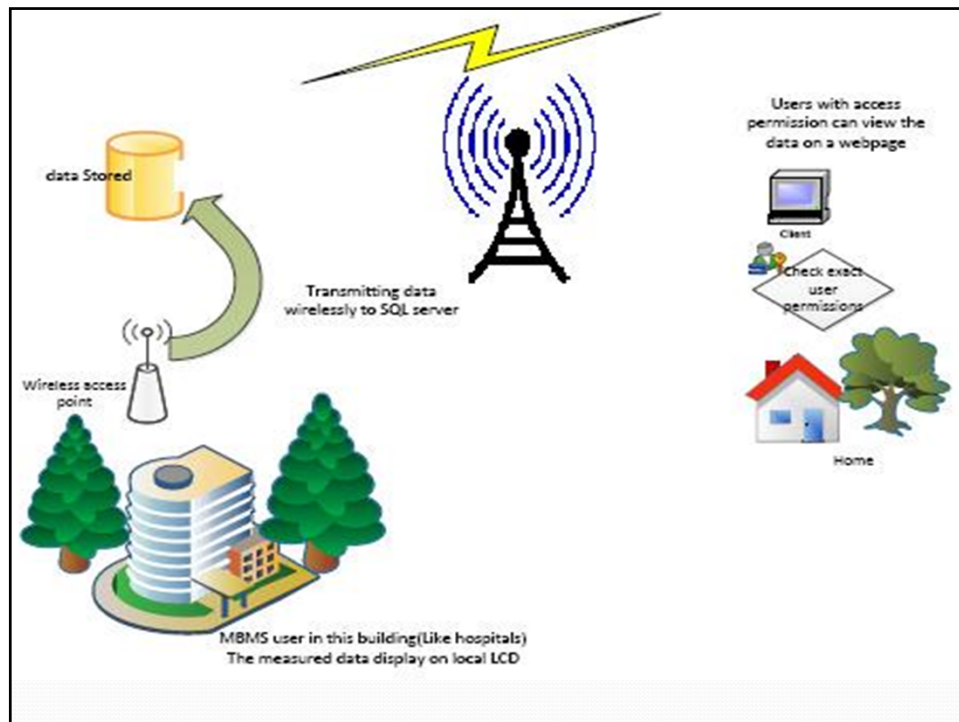
- Importance of monitoring patients
- Current situation
- Timely response to critical patients
- FCC approval of wireless spectrum for medical devices

Value Proposition

- Several patients could be remotely monitored by a single care provider.
- Improve response time and reduce overall staffing requirements.

System Overview

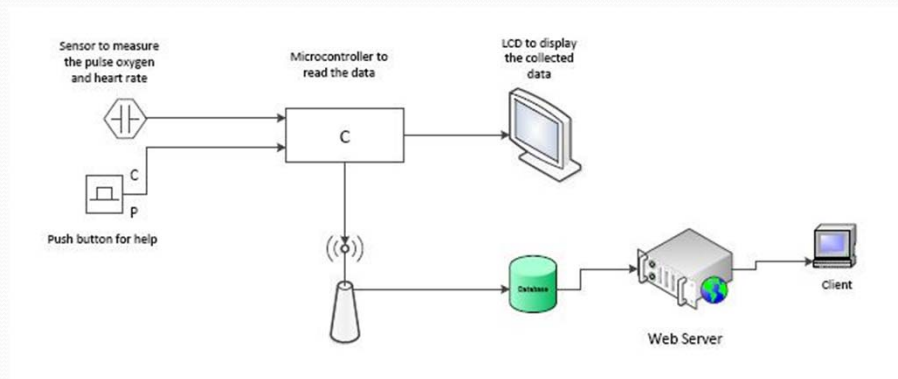
- Measures biometric data
 - Heart rate
 - Oxygen Saturation
- Collects measurements
- Send measurements to a database
- Viewable on web browser



Project Resources

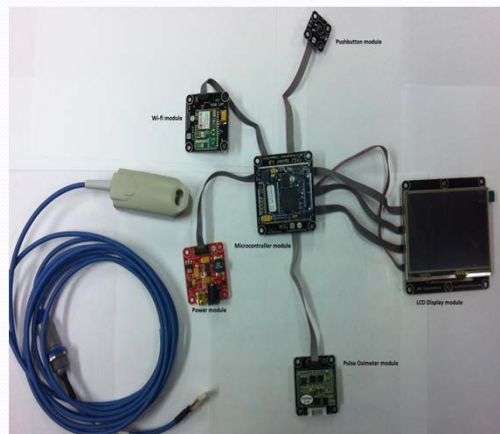
- Cost
 - Project Cost vs. Actual Cost
- Schedule (Time)
 - Projected time vs. actual time
 - Obstacles

System Design Overview



Hardware Components

- Microcontroller
- Pulse Oximeter sensor
- Pushbutton module
- Wireless module
- Power module
- LCD



Hardware Components

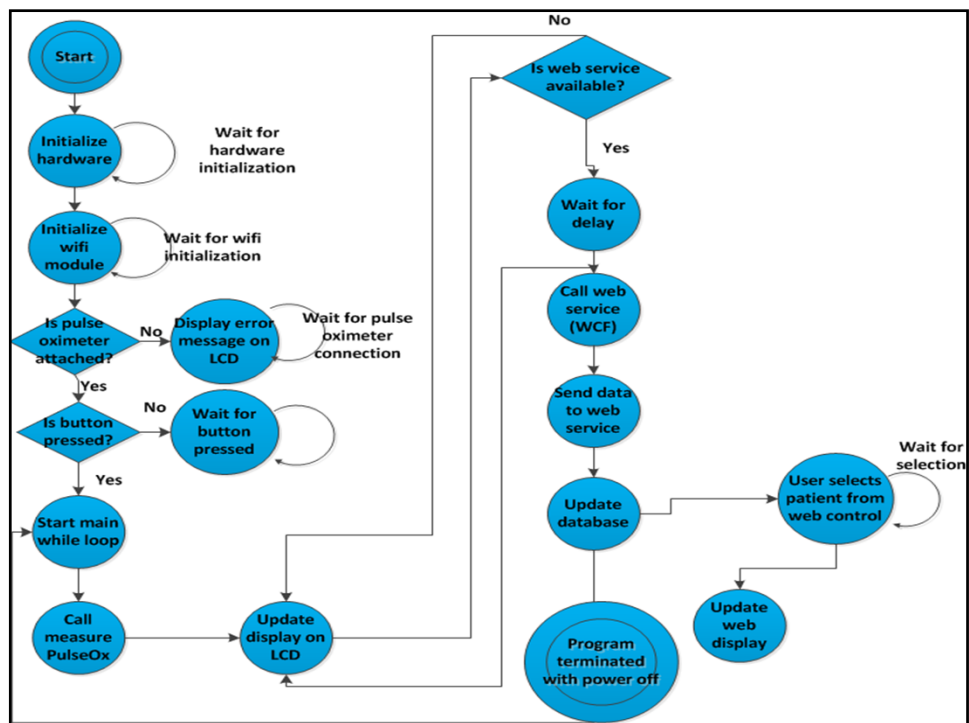
- Component research and selection
 - .NET Gadgeteer
 - Produced commercially
 - Open source code
- Component testing
 - Tools used
 - Functionality
 - Met specifications

Software Development

- Development
 - Device
 - Database
 - Web interface
- Testing

Software

Biometric Data Path



Program

```

- HRGraph: SimpleGraph
- baseFont: Font
- window: Window
- canvas: Canvas = new Canvas()
- txtStatusMessage: Text
- txtMsgHR: Text
- txtMsgO2: Text
- SignalStrength: int
- useDebug: bool = true
- name: string
- pulseRate: string
- oxSat: string
- timer: GT.Timer
- IsNetworkUp: bool = false
- IP: string

- ProgramStarted() : void
- setupWindow() : void
- pulseOximeter_ProbeDetached(sender: PulseOximeter) : void
- pulseOximeter_ProbeAttached(sender: PulseOximeter) : void
- pulseOximeter_Heartbeat(sender: PulseOximeter, reading: PulseOximeter.Reading) : void
- pulseOximeter_Heartbeat(sender: PulseOximeter, reading: PulseOximeter.Reading) : void
- button_ButtonPressed(sender: Button, state: Button.ButtonState) : void
- timer_Tick(timer: GT.Timer) : void
+ SendPulseOxData(name: string, pulse: string, oxg: string) : void
- req_ResponseReceived(sender: HttpRequest, response: HttpResponse) : void
- startWiFi() : void
- wifi_RS21_NetworkUp(sender: GTM.Module.NetworkModule, state: GTM.Module.NetworkModule.NetworkState) : void
- wifi_RS21_NetworkDown(sender: GTM.Module.NetworkModule, state: GTM.Module.NetworkModule.NetworkState) : void
- Interface_WirelessConnectivityChanged(sender: object, e: WIFIR59110.WirelessConnectivityEventArgs) : void
+ NTPTime(TimeServer: string, GmtOffset: int) : bool
- Interface_NetworkAddressChanged(sender: object, e: EventArgs) : void

```

Database

- Used SQL Server 2008
 - Originally developed three table
 - Reduced to two table for time

Web Interface

- Local Internet Information Service (IIS)
- ASP.NET web pages

MODULAR BIOMETRIC MONITORING WEB

Home Monitor About

MONITOR

This is the monitor page

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HeartRate	OxSat	TxTime
86	99	4/24/2013 9:19:00 PM
92	98	4/24/2013 9:18:50 PM
93	99	4/24/2013 9:18:40 PM
96	98	4/24/2013 9:18:30 PM
100	98	4/24/2013 9:18:20 PM
96	98	4/24/2013 9:18:10 PM
91	98	4/24/2013 9:18:00 PM

WCF Service

- Windows Communication Foundation (WCF) provides unified programming model and runtime support for building Web services applications
- Tested with WCF Client Tool

Significant Risks

- Risk 6: Improperly written code cause delay in software delivery
- Risk 9: Unable to access proper SQL server forces modification to project scope
- Risk 10: WIFI encryption not supported by selected wireless device forces modification to project scope.

Requirements Testing

The system shall measure heart rate	Demo, Passed
The system shall measure blood oxygen	Demo, Passed
The system should send data to a database	Demo, Passed
The system should utilize a local display	Inspect, Passed
The system shall measure heart rate to within 5 bpm	Analysis, Passed
The system shall measure blood oxygen to within 3%	Analysis, Passed
The system should write to the database between 20-30 seconds after measurements are complete	Demo, Passed with change to about 10 s
The system should update the LCD within less than 5 seconds	Demo, Passed with change to about 1 s

Lessons Learned

- Using time efficiently to achieve the goal
- Applying relevant education experience
- Dividing the project into tasks
- Following the project time line
- Lack of training in C# programming language
- IPFW computer labs did not support development in C#

Future Development

- Secure website development
- Update database schema to support secure website
- Encrypt biometric data
- Enable touchscreen for interaction
- Build the logic to detect out of range data
- Enable alerts for data out of range
- Develop suitable battery pack



Questions...