Proceedings of the 6th International Electronic Conference on Sensors and Applications, 15 – 30 November, 2019, Sensors MDPI, Basel, Switzerland.

A CONFERENCE PAPER PRESENTATION

By:

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Paper Title:

An IoT-Based Smart Framework for Human Heartbeat Rate Monitoring and Control System

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Presentation Outline

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- Introduction
- Motivation and Related Works

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- System Architecture and Design
- Experimental Results

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- Conclusion, Future Work
- Acknowledgement
- References

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Introduction

- This research paper presents the design and implementation of an internet of things (IoT) based smart framework for human heartbeat rate monitoring and control system.
- A comprehensive study of various techniques and technologies that are used in controlling the heartbeat rate is explored.
- The proposed system is designed and implemented on a breadboard with the various system components that are assembled, connected and tasted.
- Experimental results obtained from the implemented prototype were found to be accurate, as the system was able to sense and read the heartbeat rate of its user and transmits the sensed data through the internet.

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Introduction Cont'd

- The system components were soldered on a breadboard, and cased inside a plastic container with the heart pulse sensor stretched, so as to be clipped on the finger tip of the system's user.
- Experimental results demonstrate that the resting heartbeat rate of children below the age of 17 is between 65 to 115 beats per minute (BPM) and the resting heartbeat rate of an adult between the ages of 17 to 60 is 60 to100 BPM.
- In addition, the resting heartbeat rate of old people who are sixty years old and above, their heartbeat rate is between 65 to 120 BPM respectively.

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Introduction Cont'd

- These findings are in agreement with the state-of-the-art in the medical field.
- Furthermore, this research paper, presents an approach that is flexible, reliable, and confidential for heartbeat rate monitoring and control system,
- using sensor network and IoT technology which can be deployed to the medical field to assist the medical practitioners in doing their work easier.

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Research Contribution

- ✓ This research paper has contributed in the following:
- ✓ A working prototype to detect and monitor the human heartbeat rate in real-time.
- ✓ The system displays the user's heartbeat rate on a liquid crystal display (LCD) screen in real-time.
- ✓ The system transmits the users sensed data to the internet for analytics and visualization.
- ✓ Medical practitioners can monitor and control the patient remotely at any location.

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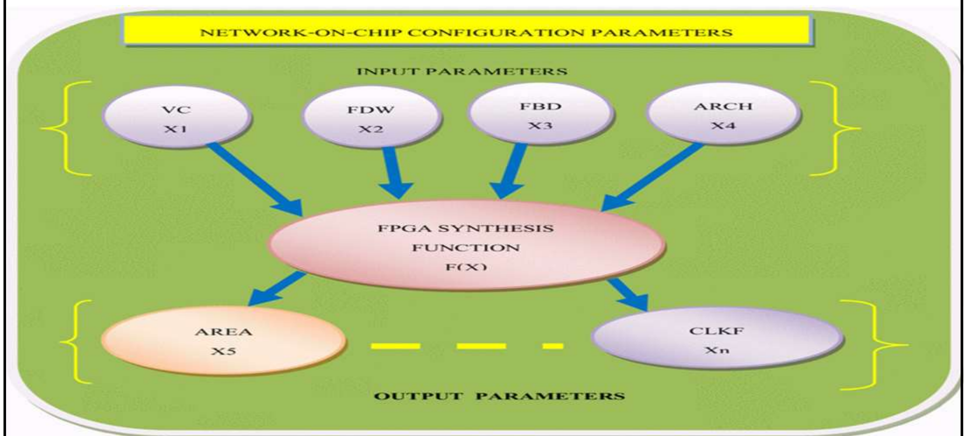
Motivation and Related Works



S. Abba and Jeong-A L., A Parametric-Based Performance Evaluation and Design Trades-off for Interconnect Architectures using FPGA for Network-on-Chips, Microprocessors and Microsystems Journal, Volume 38, Issue 5, July 2014, Pages 375-398.

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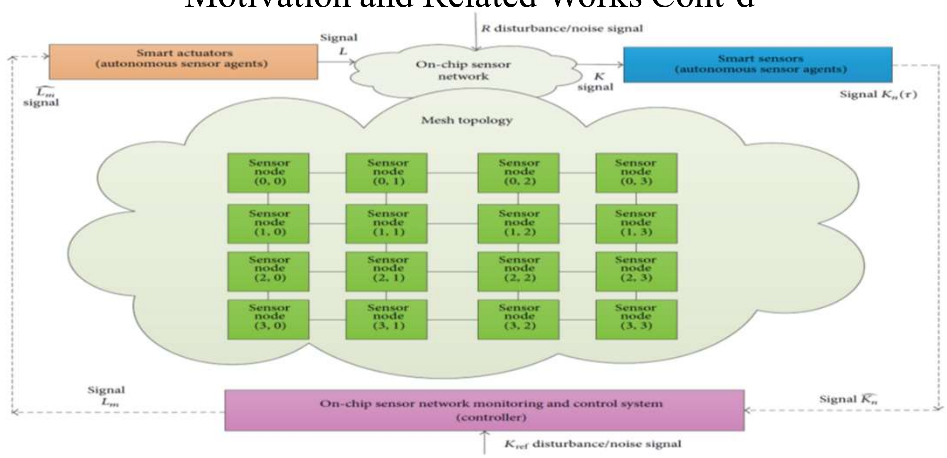
Motivation and Related Works Cont'd



S. Abba and Jeong-A L., FPGA-Based Design of an Intelligent On-Chip Sensor Network Monitoring and Control Using Dynamically Reconfigurable Autonomous Sensor Agents, Int. Journal of Distributed Sensor Networks, Volume 2016, Article ID 4246596, 29 pages.

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Motivation and Related Works Cont'd

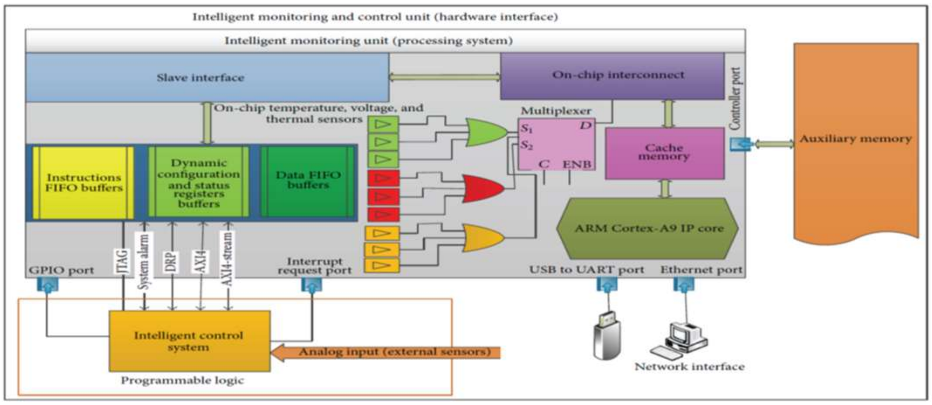

FIGURE 13: On-chip sensor network monitoring and control system (hardware interface).

S. Abba and Jeong-A L., FPGA-Based Design of an Intelligent On-Chip Sensor Network Monitoring and Control Using Dynamically Reconfigurable Autonomous Sensor Agents, Int. Journal of Distributed Sensor Networks, Volume 2016, Article ID 4246596, 29 pages.

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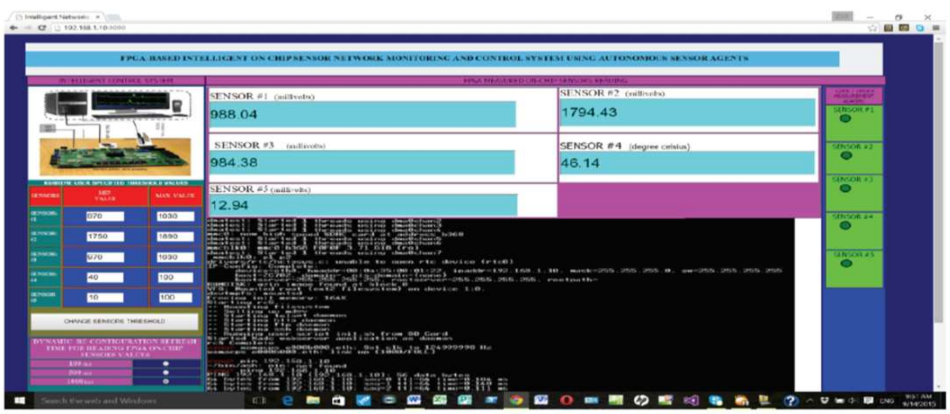
Motivation and Related Works Cont'd



(b)

S. Abba and Jeong-A, L., FPGA-Based Design of an Intelligent On-Chip Sensor Network Monitoring and Control Using Dynamically Reconfigurable Autonomous Sensor Agents, Int. Journal of Distributed Sensor Networks, Volume 2016, Article ID 4246596, 29 pages.

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Motivation and Related Works Cont’d

```
// Autonomous Self-aware and Adaptive Route Repair Technique (in ASAART)
Let Sensor_Network = sensor network consisting of sensors
Let Sensor_node = sensor node
Let d = destination node
Let k = intermediate node
Let s = source node
Let Route_Metric = route computation metric
Let AutoSelf-Awareness-Back-offDelay = use equations 4 to 10
Let RR_ACK = route repair acknowledgement packet
Let RRDP = route repair discovery packet
Let Sequence-Number_s-d = sequence number from source to destination
Let Sequence-number_i-d = sequence number of intermediate node to the destination node
Let Local-Node-Neighbor_info = set of nodes within the sender's node transmission range
Let Global-Node-Neighbor_info = set of nodes within the sender's node outside transmission range
Begin {
With s as starting node update the Global-Node-Neighbor_info (k) using the Local-Node-Neighbor_info (s)
  If (k not equal to s) and (k not equal to d) then
     If RRDP then
        If Sequence-Number_k-d greater than Sequence-Number_s-d then
          K transmit RR_ACK together with Sequence-Number_k-d
        Else if ∀ neighbors in Sensor_Network receive the RRDP then
          Discard RRDP
        Else
          Compute AutoSelf-Awareness-Back-offDelay to get the global update information
    If Sensor_node transmits RRDP and Global-Node-Neighbor_info (k) = null using equation 4 to 10 then
          Discard RRDP
        Else
             Global-Node-Neighbor_info (s) = Global-Node-Neighbor_info (k)
               Route_Metric = Route_Metric + 1
       End if
     End if
    End if
   Else if k = d and RRDP is initiated then
     Transmit RR_ACK
 End if
  }
End
```

S. Abba and Jeong-A, L., An Autonomous Self-Aware and Adaptive Fault Tolerant Routing Technique for Wireless Sensor Networks, Sensors Journal, 2015,*15*, 20316-20354.

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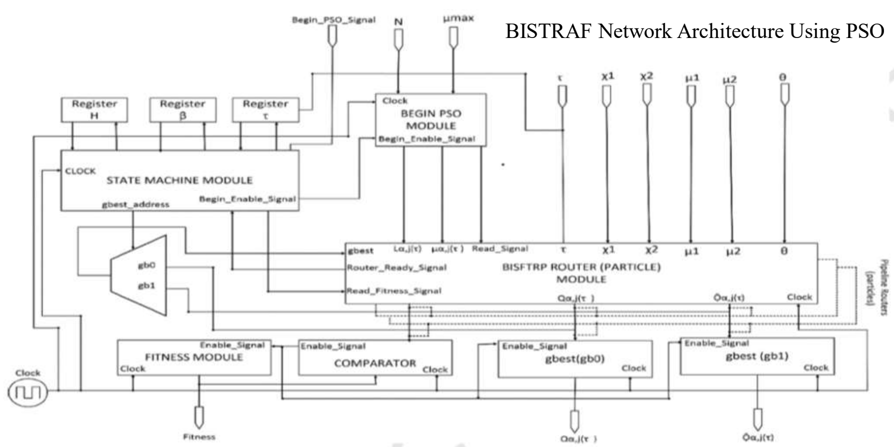
Motivation and Related Works Cont’d

BISTRAF Network Architecture Using PSO



S. Abba and Jeong-A, L., Bio-inspired self-aware fault-tolerant routing protocol for network-on-chip architectures using Particle Swarm Optimization, Microprocessors and Microsystems Journal, Volume 51, June 2017, Pages 18-38.

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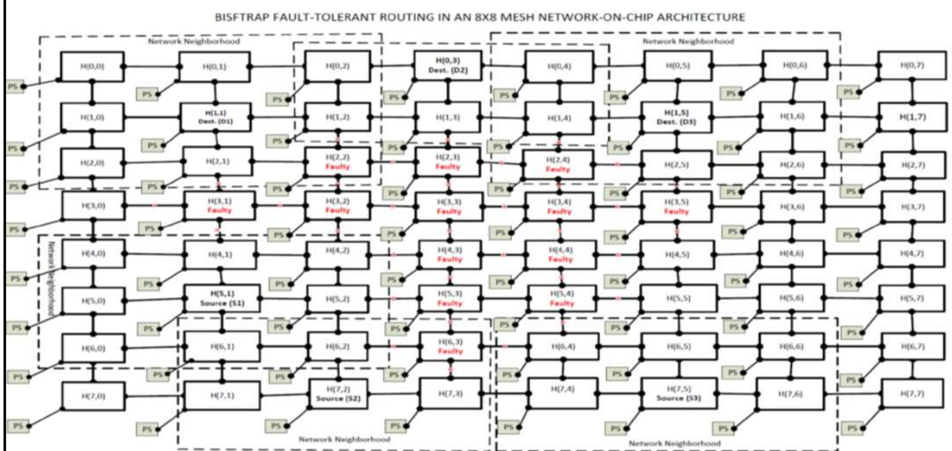
Motivation and Related Works Cont'd



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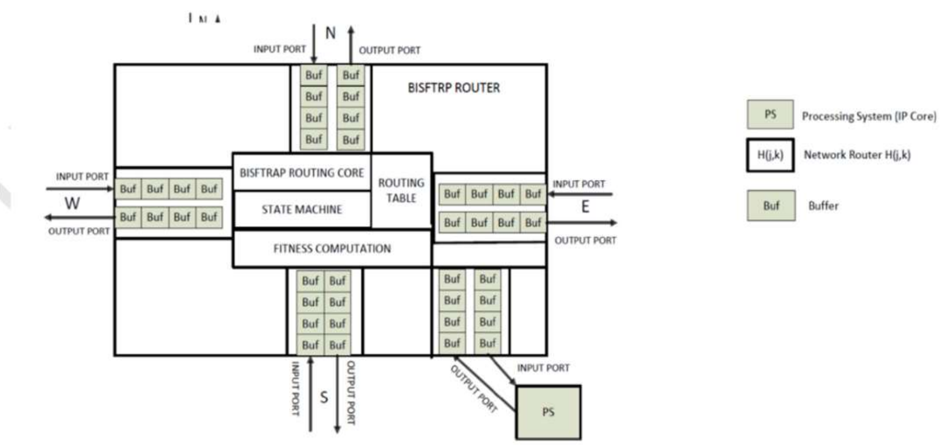
Motivation and Related Works Cont'd



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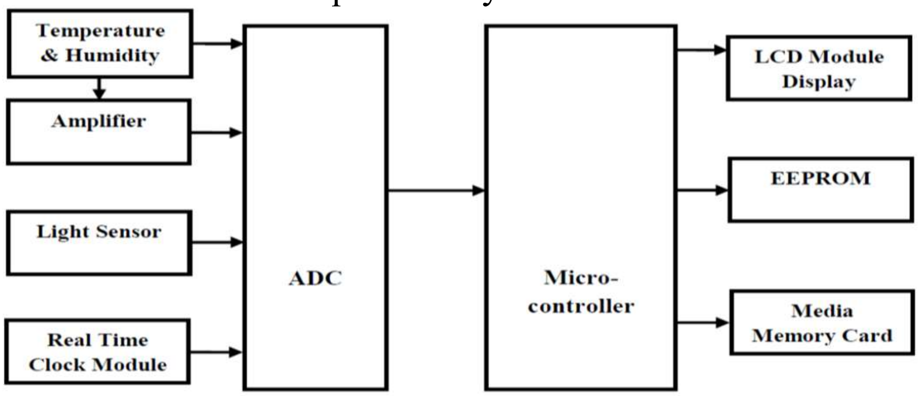
Motivation and Related Works Cont'd

Data Acquisition System Architecture



S. Abba and I. M. Nyam, Design, implementation and performance evaluation of wireless sensor networks for data acquisition system (A case study of smart homes), *in proceedings of the 1st International Conference on Microelectronic Devices and Technologies (MicDAT '2018)*, 20-22 June 2018, Barcelona, Spain, 2018, (34), 101-107.

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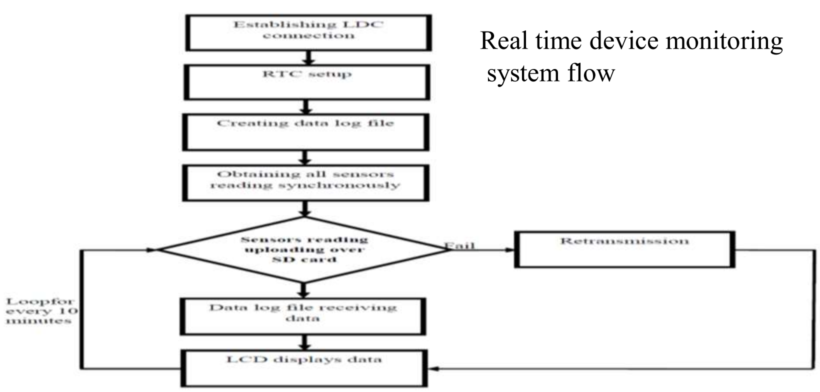
Motivation and Related Works Cont'd



Real time device monitoring system flow

S. Abba and I. M. Nyam, Design, implementation and performance evaluation of wireless sensor networks for data acquisition system (A case study of smart homes), *in proceedings of the 1st International Conference on Microelectronic Devices and Technologies (MicDAT '2018)*, 20-22 June 2018, Barcelona, Spain, 2018, (34), 101-107.

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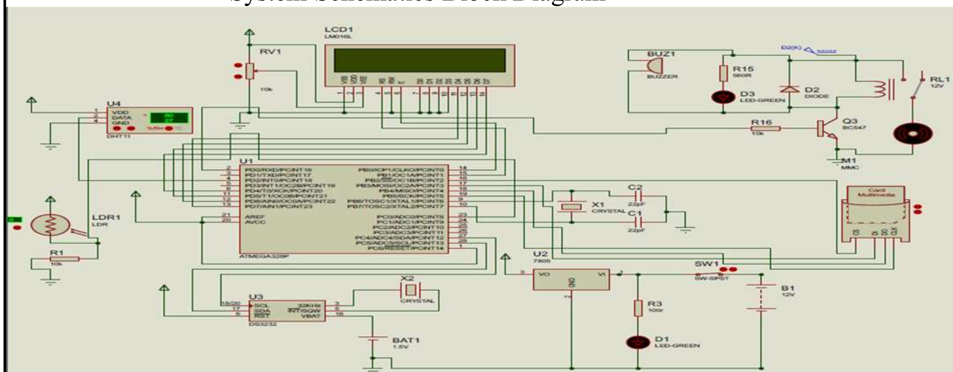
Motivation and Related Works Cont'd

System Schematics Block Diagram



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Motivation and Related Works Cont'd

The implemented Prototype

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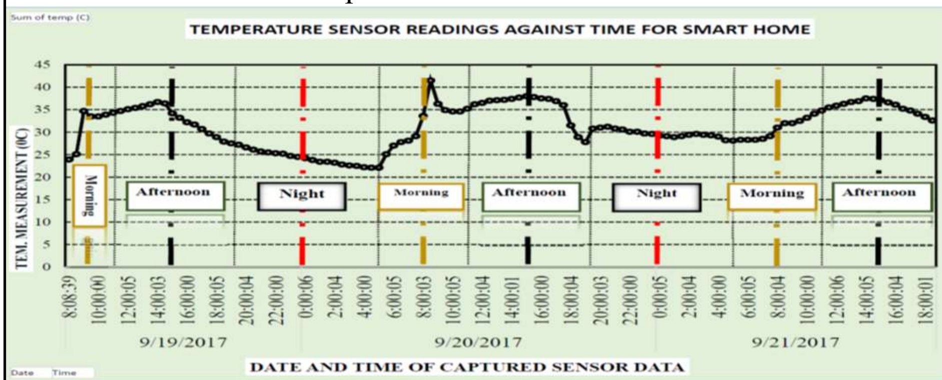
Motivation and Related Works Cont'd

Experimental Results



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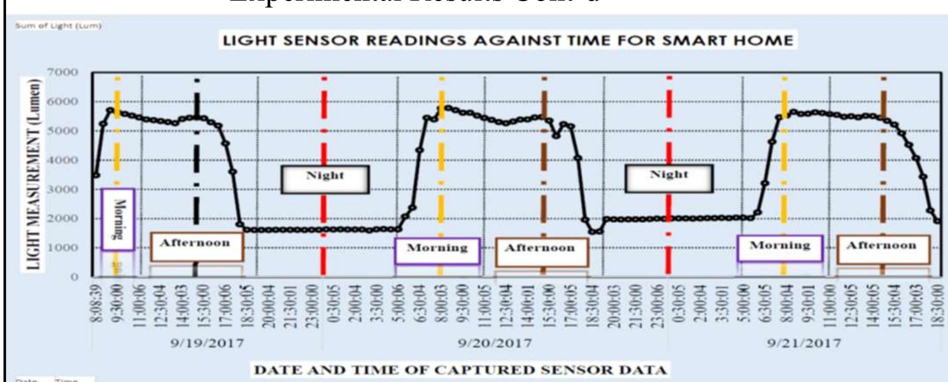
Experimental Results Cont'd



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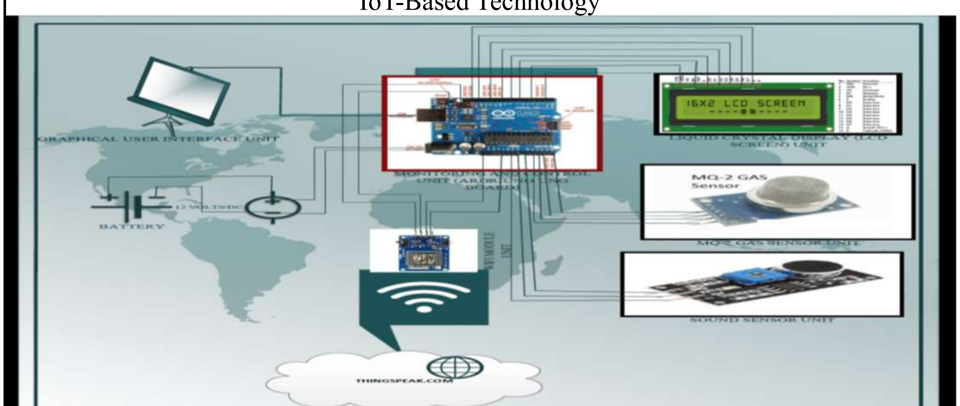
Motivation and Related Works Cont'd

Smart Framework for Environmental Pollution Monitoring and Control System Using IoT-Based Technology



Sani, A.; Beauty, P. E., Smart Framework for Environmental Pollution Monitoring and Control System Using IoT-Based Technology, Sensors & Transducers, Vol. 229, Issue 1, January 2019, pp. 84-93.

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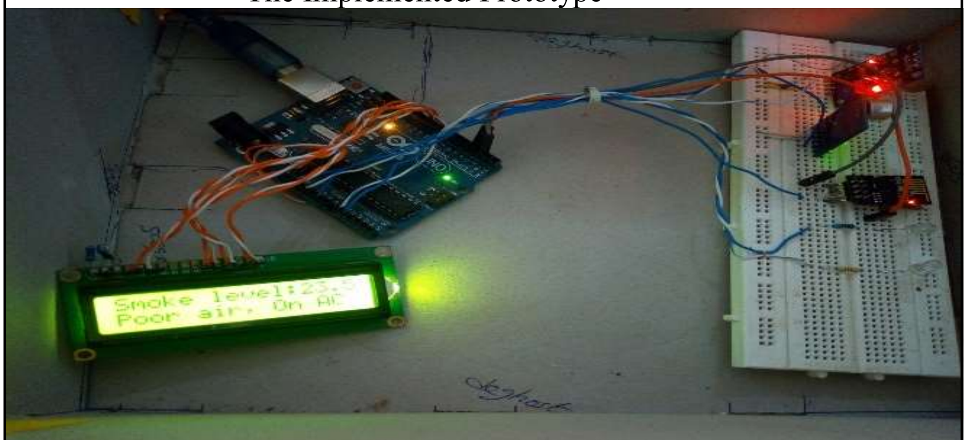
Motivation and Related Works Cont'd

The Implemented Prototype



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Motivation and Related Works Cont'd

Experimental Results (Sensor Data Logging)

1	Date_of_Captured_Sensor_Data	Entry_ID	Gas_Sensor_Readings	Sound_Sensor_Readings
2	2018-01-12 09:58:59 UTC	477	4.4	19.06
3	2018-01-12 09:59:14 UTC	478	4.4	19.06
4	2018-01-12 09:59:29 UTC	479	4.89	19.06
5	2018-01-12 09:59:45 UTC	480	4.89	19.06
6	2018-01-12 10:00:00 UTC	481	5.38	19.55
7	2018-01-12 10:00:17 UTC	482	4.89	19.06
8	2018-01-12 10:00:39 UTC	483	4.89	19.06
9	2018-01-12 10:00:54 UTC	484	4.89	19.06
10	2018-01-12 10:01:10 UTC	485	4.89	19.06
11	2018-01-14 17:27:50 UTC	486	26.25	19.06
12	2018-01-14 17:28:23 UTC	487	29.33	20.04
13	2018-01-14 17:28:45 UTC	488	23.46	19.55
14	2018-01-14 17:29:05 UTC	489	18.57	19.06
15	2018-01-14 17:29:20 UTC	490	16.62	19.06
16	2018-01-14 17:29:44 UTC	491	14.66	20.04

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Motivation and Related Works Cont'd

Experimental Results (Sensor Data Logging) Cont'd

	Date_of_Captured_Sensor_Data	Entry_ID	Gas_Sensor_Readings	Sound_Sensor_Readings
1				
2	2018-07-31 14:07:29 UTC	500	31.28	20.53
3	2018-07-31 14:07:47 UTC	501	25.42	20.53
4	2018-07-31 14:08:09 UTC	502	23.46	21.99
5	2018-07-31 14:08:31 UTC	503	30.3	21.99
6	2018-07-31 14:08:52 UTC	504	21.51	21.99
7	2018-07-31 14:09:14 UTC	505	29.33	21.51
8	2018-07-31 14:09:29 UTC	506	20.04	20.53
9	2018-07-31 14:09:46 UTC	507	28.73	20.53
10	2018-07-31 14:10:08 UTC	508	30.3	21.51
11	2018-07-31 14:10:29 UTC	509	20.53	21.99
12	2018-07-31 14:10:52 UTC	510	19.55	20.53
13	2018-07-31 14:11:10 UTC	511	19.55	21.99
14	2018-07-31 14:11:43 UTC	512	16.62	21.99
15	2018-07-31 14:11:59 UTC	513	14.17	20.53
16	2018-07-31 14:12:14 UTC	514	14.17	20.53

Sani, A.; Beauty, P. E., Smart Framework for Environmental Pollution Monitoring and Control System Using IoT-Based Technology, Sensors & Transducers, Vol. 229, Issue 1, January 2019, pp. 84-93.

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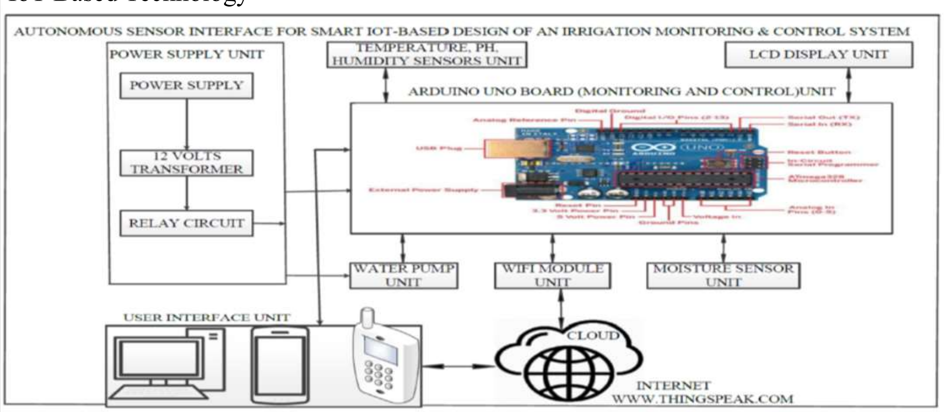
Motivation and Related Works Cont'd

Smart Framework for Environmental Pollution Monitoring and Control System Using IoT-Based Technology



Sani Abba, Jonah Wadumi Namkusong, Jeong-A Lee and Maria Liz Crespo, Design and Performance Evaluation of a Low-Cost Autonomous Sensor Interface for a Smart IoT-Based Irrigation Monitoring and Control System, *Sensors* **2019**, *19*, 3643; doi:10.3390/s19173643

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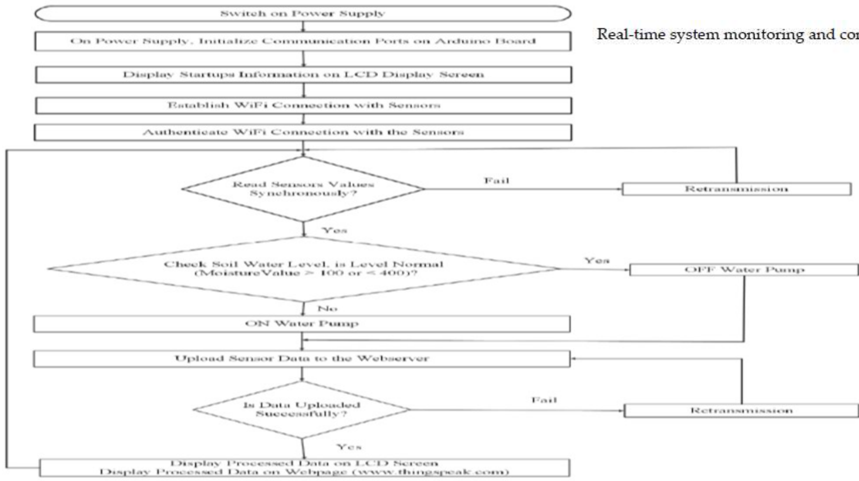
Motivation and Related Works Cont'd



Real-time system monitoring and control.

Sani Abba, Jonah Wadumi Namkusong, Jeong-A Lee and Maria Liz Crespo, Design and Performance Evaluation of a Low-Cost Autonomous Sensor Interface for a Smart IoT-Based Irrigation Monitoring and Control System, *Sensors* **2019**, *19*, 3643; doi:10.3390/s19173643

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Motivation and Related Works Cont'd

Sani Abba, Jonah Wadumi Namkusong, Jeong-A Lee and Maria Liz Crespo, Design and Performance Evaluation of a Low-Cost Autonomous Sensor Interface for a Smart IoT-Based Irrigation Monitoring and Control System, *Sensors* **2019**, *19*, 3643; doi:10.3390/s19173643

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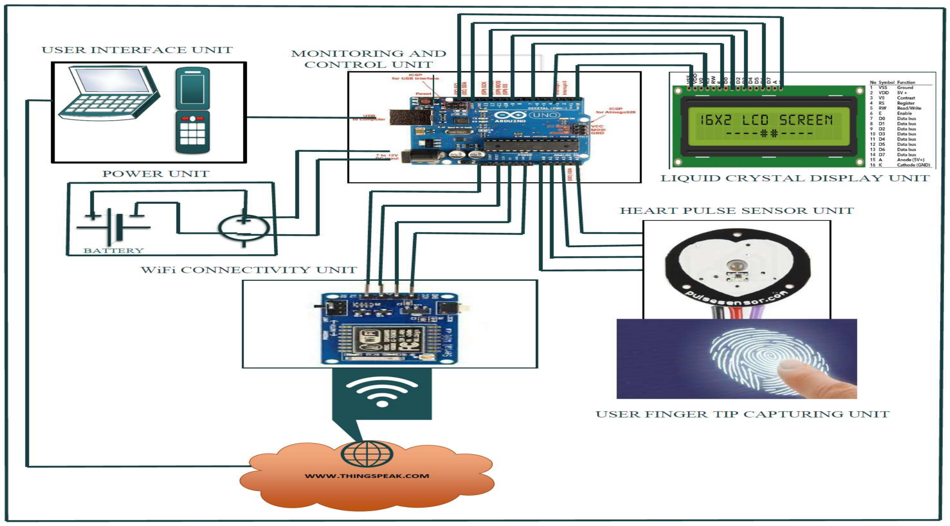
This Proposal

Proposed system architecture.



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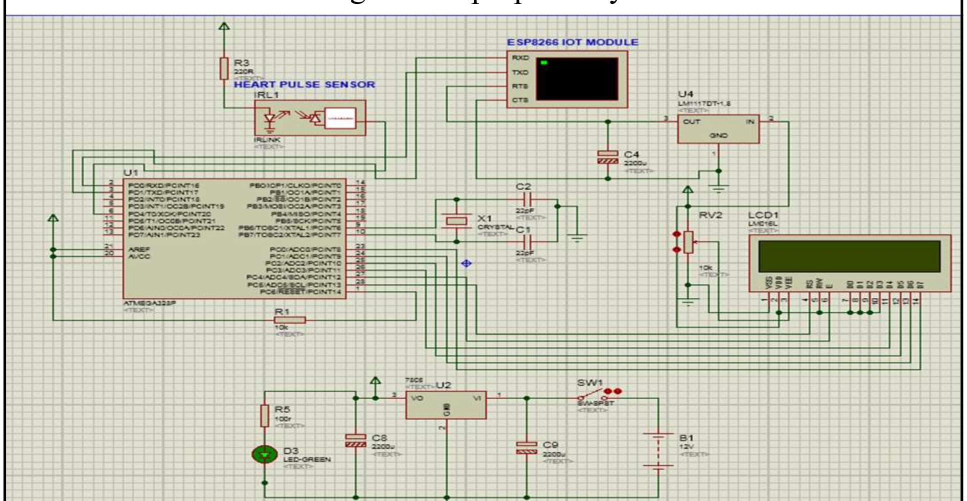
This Proposal Cont'd

Schematic design of the proposed system architecture.



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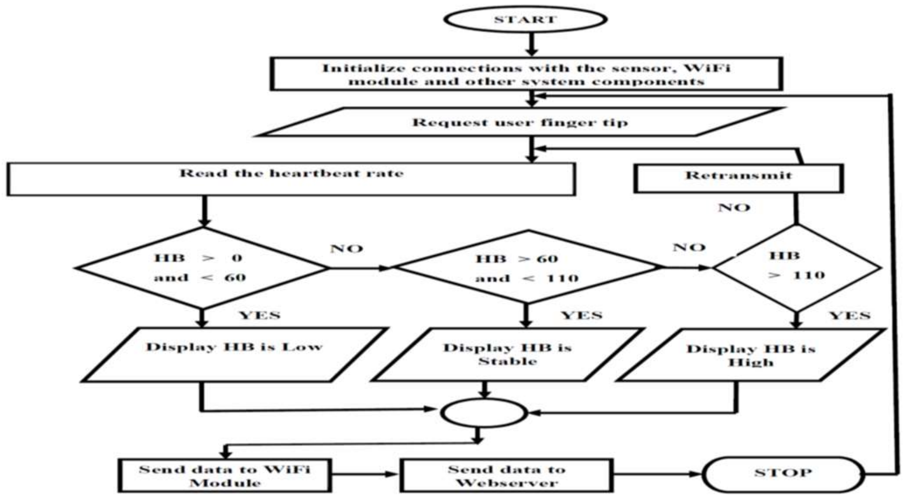
This Proposal Cont'd

System flowchart



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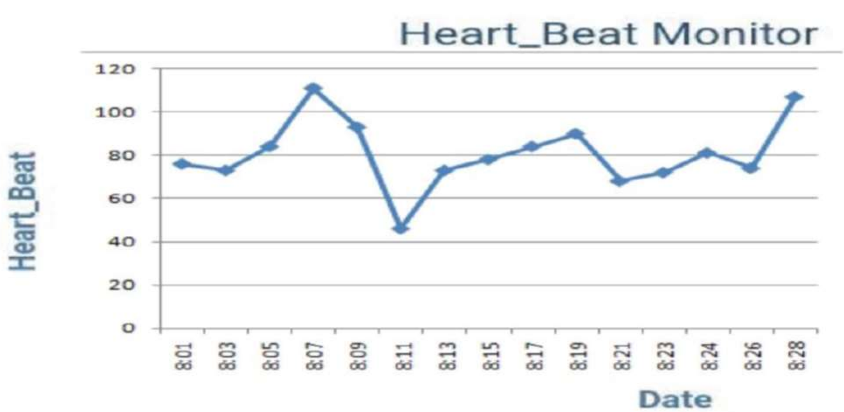
This Proposal Cont'd

Experimental Results

The heartbeat rate of an old man at rest state



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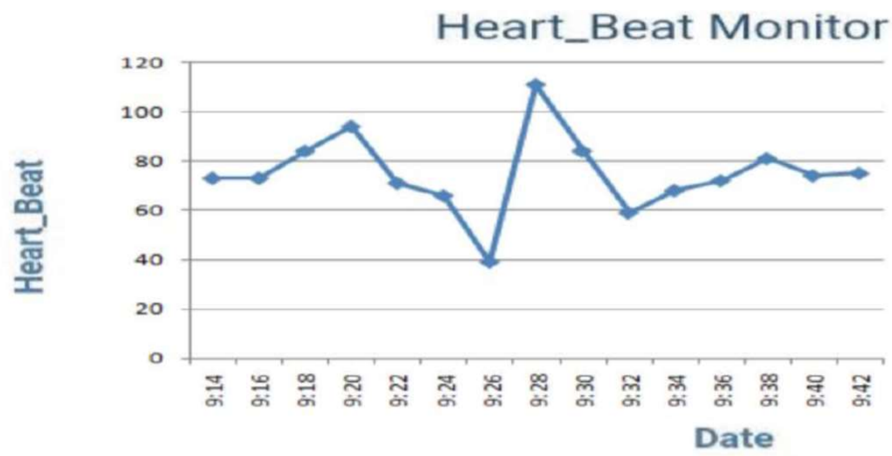
This Proposal Cont'd

Experimental Results Cont'd

heartbeat rate of an adult at rest state



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Conclusion

- An IoT based smart framework for human heartbeat rate monitoring and control system is developed.
- This system, uses the capability of heart pulse sensor for data acquisition. Human heartbeat is captured as data signals and processed by the microcontroller.
- The processed data is transmitted to the IoT platform for further analytics and visualization.
- Experimental results obtained from the implemented prototype were found to be accurate as the system was able to sense and read the heartbeat rate of its user and transmits the sensed data through the internet.

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Conclusion Cont'd

- The system components were soldered on a breadboard and cased inside a plastic container with the heart pulse sensor stretched so as to be clipped on the finger tip of the system's user.
- From the results obtained, it was found that the resting heartbeat rate of children below the age of 17 is between 65 to 115 bpm and the resting heartbeat rate of an adult between the ages of 17 to 60 is 60 to 100 bpm.
- In addition, the resting heartbeat rate of old people who are sixty years old and above, their heartbeat rate is between 65 to 120 bpm respectively.

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Conclusion Cont'd

- These findings are in agreement with the state-of-the-art in the medical field.
- Furthermore, this research paper presents an approach that is flexible, reliable, and confidential for heart beat rate monitoring and control system using sensor network and IoT technology.
- The implemented device prototype can be deployed to the medical field to assist the medical practitioners to efficiently and reliably do their work without difficulties.

Future Work

- The future work will consider different kind of heartbeat measuring parameters, and how they affect the human heart.
- The proposed system can be extended to monitor and control patient in remote locations for sustainable health care and delivery systems.
- A case study will be considered for remote patient monitoring and control system using IoT based technology.

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Acknowledgements

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