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Gazi M.A. Ehsan ur Rahman, Ph.D.

Short Bio:

**Gazi M.A. Ehsan ur Rahman** received the B.Sc. and M.Sc. in Electrical and Electronic Engineering from Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh, in 1999 and 2008, respectively. He earned Ph.D. in electrical and computer engineering from the University of Saskatchewan, Canada, in December 2022. Recently Gazi finished leading an RND team of a Canadian Startup company to develop IoT solutions for various North American industries and has been there for eighteen months. During this period, he had firsthand experience working with the IoT cloud. He also led the technical team developing and providing automation solutions to various local industries in Bangladesh for six years. Prior to that, he had the opportunity to work as an Assistant Professor in the Electrical and Electronic Engineering department of United International University (UIU), Dhaka, Bangladesh, for more than eight years. He led the Robotics team of UIU to the “University Rover Challenge” organized by The Mars Society in Utah, USA, in June 2017. During his early career, he worked for cellular service providers in Bangladesh for more than nine years, where he had hands-on experience with various telecommunication equipment and tools. His present research objectives include building the basis of a Wide-area Wireless Sensor Network (WWSN) and focusing future research on virtualization and security aspects in a cloud environment for real-time, resource-constrained devices and system-on-chips for Smart Agriculture and Health applications.

Research Page

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Short Bio:

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Wide-area Wireless Sensor Network (WWSN) with mobility:

Ph.D. research project, 2019-20.

In a WWSN, sensor nodes are distributed over a wide area, and some applications, such as Smart Livestock monitoring, may have mobile sensor nodes. The proposed Lightweight Dynamic Clustering Algorithm (LDCA) based on the Lightweight Dynamic Auto Reconfigurable Protocol (LDAP) can cover a wider area of monitoring using the Long-Range (LoRa) technology. LDAP enables the mobile data sink to acquire the data from the nodes, and the LDCA performs real-time clustering, enhancing the network capacity. Further improvement is going on to improve WSN lifetime and coverage area.

“LDCA: Lightweight Dynamic Clustering Algorithm for IoT-Connected Wide-area WSN and Mobile Data Sink using LoRa”, IEEE IoT-J, DOI: 10.1109/JIOT.2021.3079096.

“LDAP: Lightweight Dynamic Auto-Reconfigurable Protocol in an IoT-Enabled WSN for Wide-Area Remote Monitoring”, MDPI Remote Sensing, DOI: 10.3390/rs12193131.

“IoT enabled Low power and Wide range WSN platform for environment monitoring application”, 2020 IEEE Region 10 Symposium (TENSYMP).

MPP Lab, University of Saskatchewan, Project page:

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| Mobile Data Sink acquires data from the sensor nodes (A) directly or (C) through the auto reconfigurable repeater node or cluster heads. |
| C:\Users\EUR\Desktop\WQM IoT Review\air-3.jpgC:\Users\EUR\Desktop\WQM IoT Review\ph-2.jpg\\EHSAN-WD2T\Ehsan\ALL UOS\IEEE_IoT\GWF_2 Demo\IoT gateway\File FieldTest 140819\UoS river _field Data 140819.png  (a) (b) (c)  (a) Field trial using the auto reconfigurable Sensor/Repeater Nodes collecting (b) air and (c) water quality data near the Saskatchewan River. |

Plant phenotyping using the fully automated underground imaging system, Soilcam:

Research project, MPP Lab, 2019.

Soilcam is a fully automated minirhizotron that can acquire 360-degree images all the tube length up to 900CM. Its flexible design facilitates imaging using visible and IR/UV for root architecture and nutrition research applications.

“SoilCam: A Fully Automated Minirhizotron using Multispectral Imaging for Root Activity Monitoring”, MDPI Sensors, DOI: 10.3390/s20030787.

MPP Lab, University of Saskatchewan, Project page. (https://researchers.usask.ca/khan-wahid/projects.php#SmartDigitalSystemsEmbeddedSystems)

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| Minirhizotron (Soilcam) | Soilcam field setup and GUI. | 360-degree view of in-situ canola root in low N setting |

Covid social distance monitoring using smart phones:

CovidSafe research project, MPP Lab, 2020.

It is a part of the CovidSafe project of the MPP Lab, University of Saskatchewan. In this project, smartphones are used to detect social distance utilizing the BLE protocol. All the team members contributed to their part and the project to make it successful.

“COVID-SAFE: An IoT-based System for Auto-mated Health Monitoring and Surveillance in Post-Pandemic Life”, IEEE Access, DOI: 10.1109/ACCESS.2020.3030194.

WWSN and IoT platform for Smart Agriculture applications:

Research project, 2021 +

Alternate wetting and drying (AWD) is an effective irrigation method mainly used for irrigated rice production. However, unattended, manual, small-scale, and discrete implementations cannot achieve the maximum benefit of AWD. The manual operation may introduce uncontrolled methane emissions impacting the environment. Automation of AWD is a combination of three different tasks, field water level monitoring, environmental monitoring and control and monitoring of the irrigation system. It becomes more complicated with the dimension and coverage area. This research proposed an IoT platform combining three different WSNs. It provides the mathematical models required for dimensioning of the AWD system implemented on the WWSN and IoT platforms.

“Dimensioning of Wide-Area Alternate Wetting and Drying (AWD) System for IoT-Based Automation”. Sensors 2021, 21, 6040. DOI: 10.3390/s21186040.

|  |  |  |
| --- | --- | --- |
| A picture containing building, urban design, metropolitan area, urban area  Description automatically generated  Field trial using the sensor node and IoT gateway. | A picture containing cable, electrical wiring, electronics, indoor  Description automatically generated | A screen shot of a graph  Description automatically generated with medium confidenceA screenshot of a document  Description automatically generated with low confidence  Cellphone GUI and Webpage of AWD |
| A picture containing outdoor, plant, ground, mobile phone  Description automatically generated |

IoT-based Smart Health applications:

Research project, 2021 +

“A Smart Sensor Node with Smartphone-based IoMT”, 4th International Conference on Consumer Electronics Asia 2019 (ICCE-Asia 2019).

“Development and Demonstration of a Prototype e-ECG System for Telemedicine Application.” 8th International Conference on Software, Knowledge, Information Management, and Applications-2014.

“Proposed Deployments to Provide E-Health Care in Bangladesh: Urban and Rural Perspectives”, The 12th IEEE International Conference on e-Health Networking, Applications and Services-2010.

“A novel smart metering system for loss reduction and efficient load management in the power distribution sector of Bangladesh.” 2013 2nd International Conference on Advances in Electrical Engineering (ICAEE)-2013.

Industry page:

Gazi M.A. Ehsan ur Rahman, Ph.D.

Executive summary:

Gazi has over fifteen years of industrial experience with Cellular network operators, RND, IoT solution development, and manufacturing of electronics products. His products are used by industrial customers in North America and Asia. He has commercialized more than ten products leading the technical team while working in the field of Embedded systems and IoT solution development. He started his career with the AMPS and CDMA service provider Citycell (Pacific Bangladesh Telecom Ltd.) in November 1999 and continued with the GSM service provider Banglalink (An OTH company) as the Core Network Planning leads till February 2009. He started his RND and IoT product development career as the founder director of technology of eTechnologic, from February 2012 for six years and again with Doppl and WIoT Inc. Canada from May 2021 to December 2022. Besides his industrial career, Gazi taught engineering courses on Embedded systems and IoT solution design. He also took an active part in the research and supervising projects in the same field. Most of his research projects got funds, and some came into commercial products. Some of his commercial products and solutions are-

Industrial IoT products/solutions:

During his industrial career in IoT products and solutions development, he developed commercial products for various industrial applications such as renewable energy, telematics, mining, asset tracking, security, aviation, and more. These wireless sensor nodes acquire a wide range of environmental data for remote monitoring and controlling the systems wirelessly through central OMC and smartphone Apps. These nodes are connected through one or more wireless technologies like WiFi, BLE, LoRa, Zigbee, NBIoT, GPRS, and LTE. Some of these solutions are used by connecting with the Cellular site equipment (Ericson and Huawei) and payment gateways. Some of the devices are still in production and passed IS test with C1D1 certification by Intertek. (Respected companies hold the IPs of their products.)

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| --- | --- | --- | --- | --- |
| C1D1 Sensor node | SMU Unit | C:\Users\ThinkPad\Documents\My Received Files\ET_TD.jpg  TD unit | main  IP Relay status window | Smart Solar System and payment gateway |

OEM and technical service:

Gazi led teams to provide OEM product development and manufacturing and equipment and on-site maintenance service to the telecom and other industries from 2012 to 2018. Some of his OEM products are the industrial HVAC system, Solar charge controllers and Inverters. He provided maintenance support for the Industrial battery, DCDB and rectifier using Eltek, Ericson and Huawei equipment. He also led the technical evaluation, product testing, and audit projects for the renewable energy solution development and telecom industries.

Training and project development solution:

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| Focusing the academic education and skill development, Gazi designed and manufactured various educational kits for telecommunication and embedded system designing courses for undergraduate engineering students. He also manufactured locally (2004-2020) various modules and kits for the students to learn and develop their projects at very low costs. | AVR Development kit | \\EHSAN-WD2T\Ehsan\E-Technologic\Soft Expo_14\U-AVR KIT.jpg  8051/AVR Trainer Board |

Academy Page:

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Projects:

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River navigation system

Undergraduate student project, 2012-13.

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| RNS GUI showing Realtime location of 3 vehicles and text messaging dialog box. | Provides real-time GPS location of the river vehicle to follow the proper channel and avoid collusion during hazy weather conditions. It uses an ad-hoc wireless network without a cellular network and can send text messages on the screen. |

IoT projects

RNS, 3D mapping., LLEDD,

Automation and Robotic

PLC, CNC, Rover, Drone

Power and renewable energy

IDMT, MCU-BLDC, DC-Fan

Telecommunication

IBS, ISUP, ePBX,

Other

8085, 4Delta,