

Implementation of a secure & smart university Campus for SA1

1. Introduction

This project was produced to develop smart environments within an academic field to help improve academic performance. The project is based on Internet of Things (IoT) and Wireless Sensor Networks (WSN).

The university obtains multiple advantages of this project as this project enables the university to monitor and control Building Management System (BMS) and Energy Monitoring System (EMS). The provided benefits will then help the university save money by cutting the amount of electric usage that has been acquired by the university. Also smart environments will help implement security with the use of CCTV cameras and motion detection sensors that would be installed around the university campus.



Figure - 1



Figure - 4

2. Aims & Objectives

Aim of the project is to implement a secure and smart campus prototype for the University of Wales Trinity Saint David. Located within the new Waterfront Innovation Quarter constructed at SA1 Swansea.

Objectives:

- Improved learning area's
- Understanding and use of Internet of Things devices
- Research and literature review
- Design a prototype smart campus sensor and actuator network
- Implement in simulation the smart set up, and evaluate important parameters
- Build a small prototype demonstrator for smart campus IoT features
- Identifying the overall project advantages and disadvantages
- Testing and analysing results



Figure - 2



Figure - 6



Figure - 5

3. Related work

There were several different papers researched to help assist to achieve the best ability of an successful smart university campus prototype, these papers are:

- Michigan University[1-2]
- Study of Smart Campus Development Using Internet of Things Technology[3]
- Smart university, a new concept in the Internet of Things[4]
- Building automation and energy control using IoT – Smart Campus[5]
- IoT Smart campus review and implementation of IoT applications into education process of university[6]
- How Internet of Things making the university campuses smarter? QA higher education perspective[7]
- Design and field test of an autonomous IoT WSN platform for environmental monitoring[8]

4. Research Design

A physical and simulation experiment was developed and produced. The project was not able to be utilised within the whole university campus due to limitation of time and cost. The physical experiment was utilised with the use of multiple IoT monitoring devices and a wireless gateway. The simulation was produced using Netsim Simulation Tool based on IoT environments setting.

Physical Devices used to monitor the classroom environment were Temperature sensor, Humidity Sensor, LUX Sensor, Motion Detection, Light Presence sensor and a wireless gateway. Some of the physical devices are demonstrated on figure 1, 2 and 6.

The simulation experiment also conducted had serval IoT devices that all had serval features within them for the successful outcome of a smart car park implementation. The devices used within the simulation were a Closed Circuit Television (CCTV) that also operated as an Automated Number Plate Reader (ANPR), Motion detection sensors and smoke detectors.

5. Results

The experiments that were deployed were both analysed to understand if the aims and objectives of the project were met. Some of the results gathered is demonstrated from figure 6-9.

Understandings of the results gathered from the experiments:

- Simulation Packet Loss average of 30%
- Simulation Network Throughput speed average of 0.0003 Mega bits per second
- Simulation Packet analysis show average of 100% Payload Transmitted, 70% Payload Received and 30% Payload loss
- Delay output average 500000 microseconds
- Classroom Humidity readings average of 40%
- Average Light intensity level 80 LUX
- Room temperature average of 25°C

6. Conclusion

The project and the experiment were completed to the authors best ability, shown by the results gathered it shows that the simulation experiment was not met to an very beneficial success due to the amount of network set back that were produced which can be improved with the use of different network devices. The physical experiment and the project report was a success within the authors findings and recommendation, this is due to the successful outcome results provided by the Imonnit IoT sensors.

Future redocumentations that require to be focused on:

- IEEE protocol Standards
- Security
- Simulation tool's
- Further in-depth secondary research
- Use of alternative devices for physical experiment

7. Reference's

- [1]"14 Rules for Becoming a Smart College Shopper - Robert Ronstadt - Google Books." [Online]. Available: https://books.google.co.uk/books?id=Y5dml8Qin4Cpg=PA24&dq=michigan+university+smart&hl=en&sa=X&ved=0ahUKEwin_o6ZztfaAhWhKCAKHVMWBesQ6AEILDAB#v=onepage&q=michigan+university+smart&f=false. [Accessed: 26-Apr-2018].
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- A. Majeed and M. Ali, "How Internet-of-Things (IoT) making the university campuses smart? QA higher education (QAHE) perspective," in *2018 IEEE 8th Annual Computing and Communication Workshop and Conference (CCWC)*, 2018, pp. 646-648.
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7. Motion detector readings
8. LUX sensor readings
9. Simulation Packet Loss results

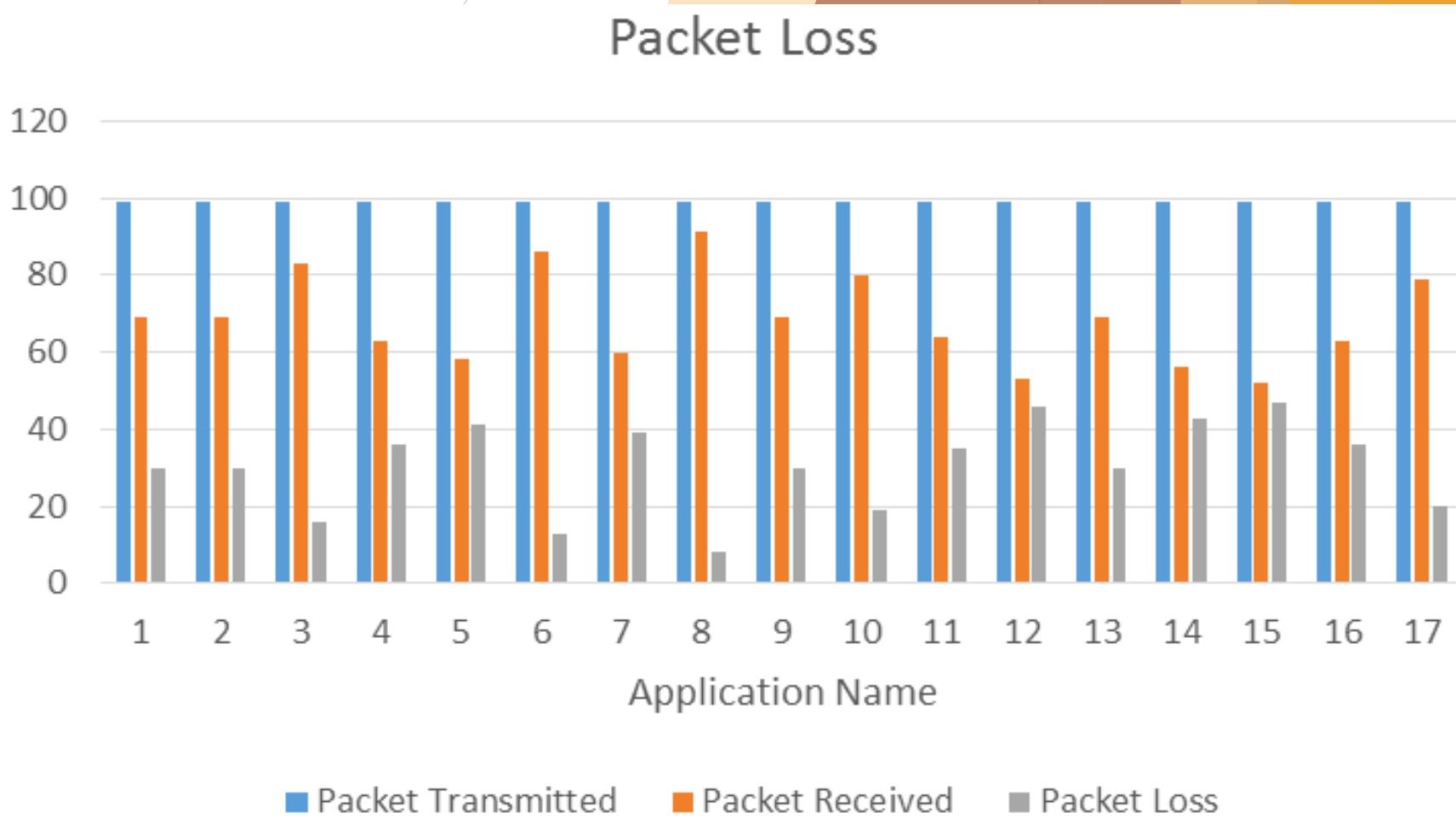


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