PUBLIC TRANSPORTATION OPTINIZATION

Fig. 2 NETSIM simulation of the 50 seat sensor design

IV. EXPERIMENTAL SETUP

A. The Node

Each node consists of 3 main components:

1) The Velostat piezoresistive sensor + voltage divider

2) The Arduino Nano micro-controller

3) The nRF24l01 transceiver

The Velostat's resistance changes as pressure is applied when someone sits on the seat. This change in resistance is converted to a voltage change using a voltage divider circuit. The voltage change is measured and converted to a digital signal by the ADC on the Arduino Nano microcontroller. The Nano is also used to threshold the pressure applied to differentiate between a person and a bag/suitcase. The Nano then transmits the data at 2.4GHz over the nRF24l01 module. The library used is the RF24 library that allocates addresses to a particular channel over which the transmission occurs.

The Raspberry Pi receives the incoming packets through the nRF24l01 module. All nRF interfaces are SPIs (Serial Peripheral Interfaces). The RPi then calls the URL for the FreeBoard cloud services that hosts a web link to display the received seat status. This status can be accessed over

V. RESULTS AND DISCUSSION

The software simulation results were quite promising with an Average Throughput of 89 bps and an Average Delay of 0.516 seconds. The hardware prototype also gave promising results with a final resulting real time delay of 4.58 seconds with an internet connection speed of 1 Mbps. The delay was between pressing the sensor and the occupancy changing on the website. This is well within expected limits and can be improved by increasing internet connection or using better cloud systems that offer paid services. The plots for two test cases of the piezo resistive sensor output is given in Fig. 5. The webpage hosted can be seen in Fig. 4(b). This particular experimental setup is scalable to 42 sensors since each Arduino Nano can support 7 sensors and the nRF24l01 can simultaneously transmit and receive across 6 channels. To go further beyond in capacity, addressing schemes need to be introduced for channel allocation.

Fig. 5(b) Small weight followed by a human

VI. CONCLUSION

Given the increasing need for crowd management systems in today's public transport and the paucity of IoT implementation in the same, this project has demonstrated a robust, cheap and scalable system to mange crowds in public transport. The software simulation was carried out to check feasibility of such a system to work in a real time environment. The project design was built and tested for various loads and seating profiles to better estimate the threshold. The prototype was built and tested in real time seating environments. The final results show promise for implementation in the real world. Further work can be done to account for standing passengers, implementing addressing schemes to increase scalability and introduce web development to improve the webpage interface.

ACKNOWLEDGEMENTS

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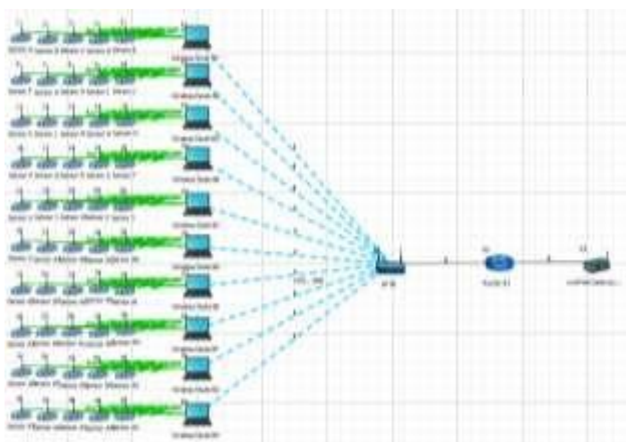

Fig. 2 NETSIM simulation of the 50 seat sensor design

any web browser or mobile application as shown in Fig. 4(b).

Fig. 4(a) Gateway

Fig. 4(b) Freeboard IoT Output

EXPERIMENTAL SETUP

A. The Node

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1) The Velostat piezoresistive sensor + voltage divider
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Fig. 3(a) Single seat node

Fig. 3(b) 4 seat setup

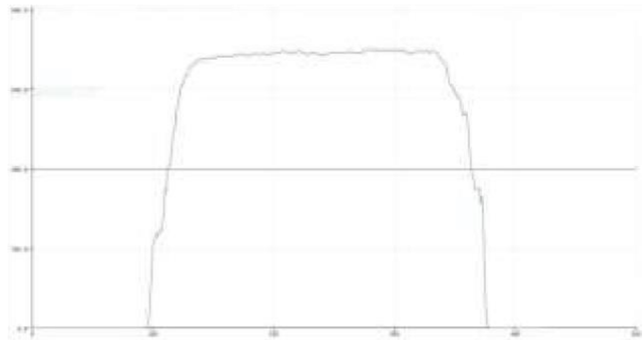
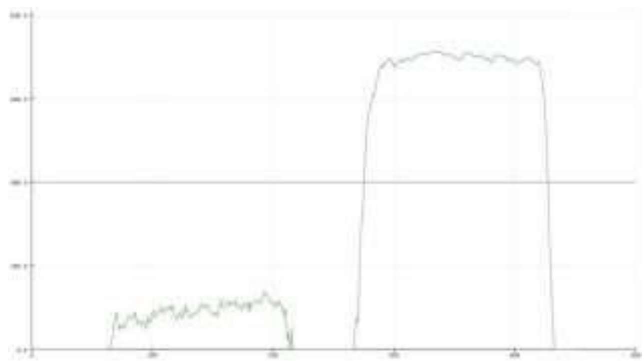


Fig. 5(a) Sitting profile of a human (>40Kg)



B. The Gateway

The Gateway consists of 3 components:
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2) The nRF24l01 transceiver
3) The FreeBoard IoT platform

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