Career Episode 1

Analysis of IoT Node Performance in the Internet of Things

A) Introduction

[CE 1.1]

Title: Analysis of IoT Node Performance in the Internet of Things

Duration: [Date] – [Date]

Location: Melbourne, Australia

Organization: Swinburne University of Technology

Position: Electrical & Electronics Engineering Student

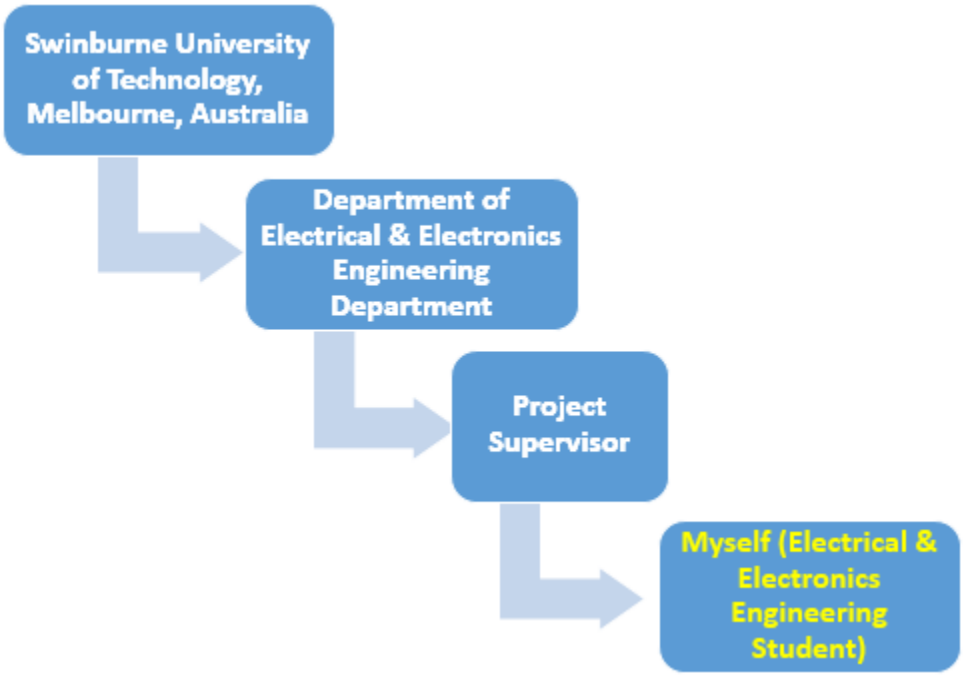
B) Background

[CE 1.2] The wireless technologies like Lora, WI-Fi, BLE assist IoT in meeting the application needs that require IoT devices wireless connectivity. Networking technologies selection is a crucial task for IoT applications due to the capabilities of wireless technology. The reliability and performance needs of IoT applications mainly vary. Specifically, the IoT node's performance and reliability can be impacted including the energy sources, time among two transmissions, communications range, and payload.

[CE 1.3]The work aim was analyzing the parameters and obtaining the optimum power communication solution. I met the IoT applications requirement at hand and enabling the IoT sensor nodes for automatically switching from one lower power communication technology to another. It was for providing optimum performance and reliability.

[CE 1.4] The work activities in the project were divided into several stages and obtained the technical activities within the specified work timeline with the consistent electrical and electronics engineering skills implementation.

[CE 1.5]



[CE 1.6] Duties:

- I researched the IoT node performance which was linked with the experimentation obtained using electrical and electronics engineering concepts.
- I made BLE characteristics usage in the indoor and outdoor at the transmitter side.
- I utilized two cellular devices which mainly contained version from BLE and it was specifically for checking the numerous performance versions.
- I researched the IoT node which was associated with the Wi-Fi mode operational value.
- I conducted the research on the LoRA which was linked with the variable power transmission associated with the data transmission mainly attained using the Electrical & Electronics Engineering concept.

C) Personal Engineering Activity

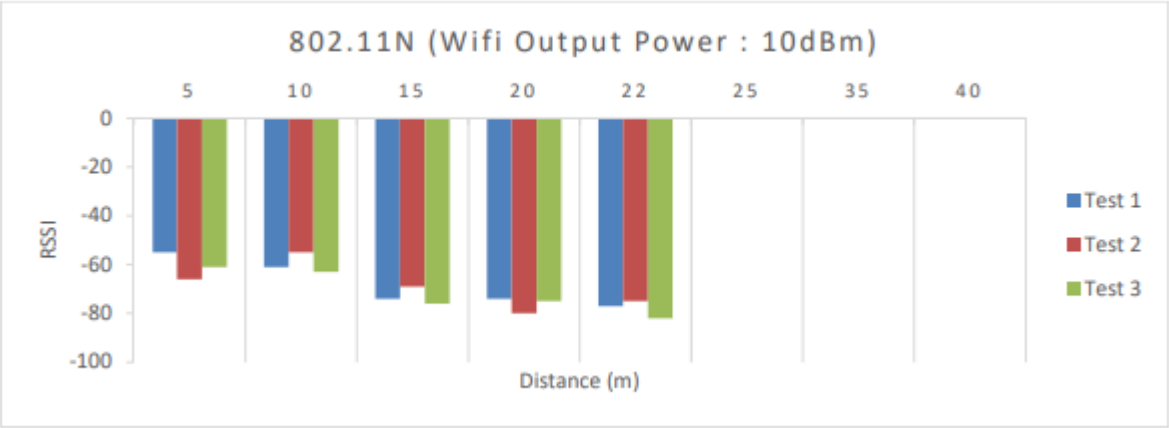
[CE 1.7]I analyzed the IoT node performance which was based on various factors considered. I researched setting borders for making it understandable. I analyzed the concept based on focusing on the IoT node performance along with improvements. I obtained the performance which was based on power consumption and conducted the payload with the time interval transmission. I aimed towards understanding the aspects which were directly or indirectly dependent on performance. I utilized the three technologies which were based on carrying out the research. I performed experiments with readymade IoT modules that were present in the market. I analyzed performance modules with a specific technology. There was a communication aspect with a focus made on the point to point communication. I utilized the BLE characteristics in the application (indoor and outdoor) at the transmitter side. I used two cellular devices which contained various BLE version for checking the various performance version. I analyzed the LoRa technology with wide transmission frequency selection from 400 MHz to 800 MHz frequency band. Also, I researched on the limitation of the 400MHz transmission frequency.

[CE 1.8] I researched the wireless technologies and other related important parameters. I used three varied IoT boards in which each board was featured with one wireless technology. It also arrived from the variable radio frequency parameters like operation mode, payload, and transmission power. I noted that each technology did not provide the variable RF parameters as compared to others. I utilized features variable RF parameters for IoT boards. I researched and obtained data sheets of IoT sensor nodes for optimum understanding. I obtained various parameters that were dependent on the specified technology. I obtained the current consumption (mA) which was based on the two different versions.

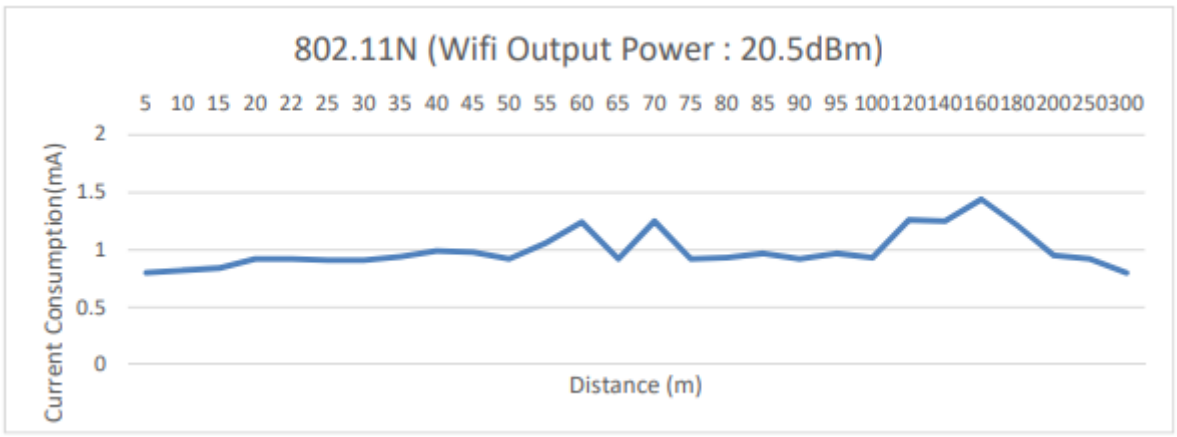
Wi-Fi Version	Current Consumption (mA)		
	Active Mode	Light Sleep Mode	Deep Sleep Mode
802.11b/g/n	0.78	0.22 (Disconnection with another node happened)	0.06 (Disconnection with another node happened)

[CE 1.9]I selected the soil temperature sensor with the sensor mainly powered from energy sources along with IoT node consideration made at a time. There was an assumption made based on the sensor temperature due to the deep irrigation connection to crops and higher along with lower water levels mainly impacted the crops. There was the question faced related to the IoT node power source which was based on selecting the experimental research and making familiar with the research concepts. The performance was attained with the defined Payload, TTI, and range performance which led towards the consumption of lesser energy and getting 100% accuracy on the delivery rate. There was the payload analyzed based on 8 bytes and TTI was set to 1event/hr. I researched the IoT node which was linked with the operational Wi-Fi mode and it resulted in obtaining access from anywhere. I selected the solar IoT node based on the LoRa due to the power generation impact from solar which varied from the sunlight intensity. I realized that the higher sunlight resulted in

providing more power generation and IoT node worked on the selection of the solar as the power source. Furthermore, I obtained the output power relation of Wi-Fi with the distance as indicated in the graph below.



[CE 1.10]I executed the experiments based on Wi-Fi physical model alteration and graphical results were obtained accordingly which were associated with the Wi-Fi power output. There was linking done on the RSSI value which reduced with the increment of the distance among the station node and AP. I set the disconnection mode of the Wi-Fi which was after reaching the RSSI pick point and node worked for scanning the Wi-Fi. I researched various nodes with different ranges and these ranges were 20 meters apart from each other. I conducted experimentation based on the indoor environment. I also made research on another application which was specifically from the chemical manufacturing field. I selected the temperature sensor for sensing the boiler and the material in the boiler was responsible for altering the characteristics because of the improper temperature. I realized that the boiler expansion occurred if the temperature was not maintained within the boiler. It was adequately based on checking the temperature when the boiler reached the cut-off temperature. I obtained the safe temperature sensing process which was based on an assumption of an array of four temperature sensors. I used each sensor for activation based on the software requirement.



[CE 1.11]I researched the IoT which was provided an optimum platform for connection of various IoT nodes and data was shared accordingly between the parameters. I obtained the IoT nodes bunch which created a higher network for sharing information. I noted that the information was able to share from various platforms which included LoRA, BLE, and Wi-Fi. It was problematic for the selection of wireless technology for meeting the needed IoT application performance level. I measured the performance in range, payload, and transmission time interval terms with the consumption of energy based on the lowest possible IoT node.

D) Summary

[CE 1.12]I concluded that the technology selection was possible without impacting the IoT node. I analyzed the parameters which were accounted for switching selection. There were considerations made on the range, source, and payload for an optimum energy source. I also attained a better understanding of realizing the parameters for maintaining the IoT node performance level. I set the BLE value which was provided optimum performance with lower energy consumption and utilized in the application which was linked with a lower transmission time interval. I researched the LoRa which provided variable transmission power features with the range based on considering the data transmission. I noted the Wi-Fi consumption which was based on the highest energy consumption during communication and features with varied sleep mode. It was optimum for higher transmission time interval consideration. There were adequate enhancements made in my electrical and electronics engineering knowledge with the activities accomplishment.

Career Episode 2

Highly Secured Traffic Management System

A) Introduction

[CE 2.1]

Project: Highly Secured Traffic Management System

Duration: [Date] – [Date]

Location: India

Organization: Government Engineering College, Gujarat

Position: Electrical & Electronics Engineering Student

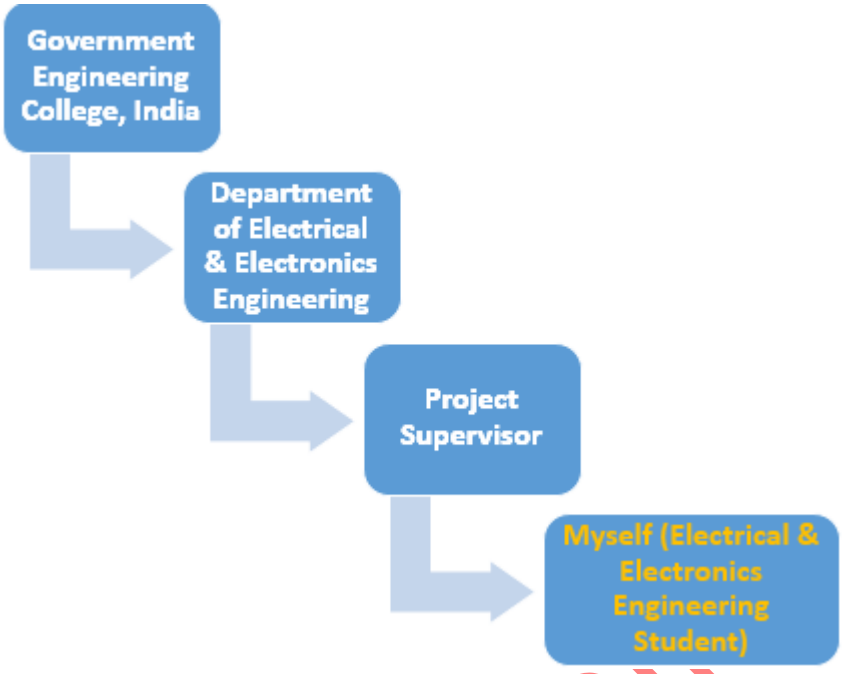
B) Background

[CE 2.2] It is adequate for the railway control system to execute the controlling of the delays and efficiently managing the system. The railway traffic system requires optimum management and controlling the train schedule along with the connections and so on.

[CE 2.3] The project aim was the identification of the object-oriented method for catering to the railway control system requirements. I executed the simulation study which was based on presenting the model and it was flexible with partial automation obtained for the traffic system for the railways. It assisted in providing adequate control and management. I implemented the project which worked as the three-field combination and these were signaling & switching wireless communication, and electronics for the railway system. Thus, the project was done in the academic year with the consistent electrical and electronics engineering field.

[CE 2.4]The work nature was completely dependent on the railway traffic control system management which was compatible with the public transport system. The project was completely based on wireless serial communication and the work activities were achieved with the implementation of the technical skills.

[CE 2.5]



[CE 2.6] Work duties:

- I did XBEE module utilization for wireless communication link establishment among the train and display modules at a specified platform.
- I did the capacitors' connection for DC smoothing along with LED which worked for power supply indication.
- I conducted the simulation study which was dependent on model presentation and it was appropriate with partial automation specifically obtained for the railways.
- I carried out each component programming with IDE and it was supported with adequate understanding and it led towards sorting the associated work issues.

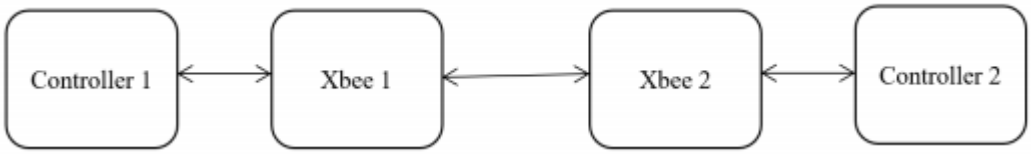
C) Personal Engineering Activity

[CE 2.7]I used the open-source platform for developing the project in which I utilized off the shelf boards like GPS, GSM, XBEE, Arduino, etc. I justified the logic with the board assistance and executed the flowchart. I carefully worked on critical reasoning and executed the logic for satisfying the work objectives. I developed the basic power supply units which were of +5V and +12V DC for running hardware modules and sensors. I connected capacitors for DC smoothing and LED for power supply indication. Furthermore, I utilized various components which included GPS Module, Arduino Uno, XBEE, Ultrasonic sensor, Accelerometer, LCD, Vibration Sensor, LED, IR sensor, and DC motor.

[CE 2.8] I implemented and simulated the project work with Arduino and there was the mandatory thing considered related to Arduino software. I simulated the work activities with the Arduino software and all modules simulations were done and presented accordingly. I initially downloaded the software and followed the steps for carrying out the downloading. I even included the simulation steps along with the consideration made on the implementation of the related work activities. I

used the GSM900 module in the project which was for monitoring the critical situation like a collision of a shortage of power. I utilized this module with the aim of train location and updating the control room to live data. I used the GSM900 module which worked as the wireless communication and utilized AT command set for carrying out communication. I set the wireless communication among the driver and control room. I operated the module operation which was on +12V DC and powered up with the adaptor usage. I used the leading telecom company SIM card for obtaining the optimum coverage. In the project, I mainly focused on the volatile movements and decided to execute them with battery. However, with the financial backing, there was the switch connected to the adaptor supply.

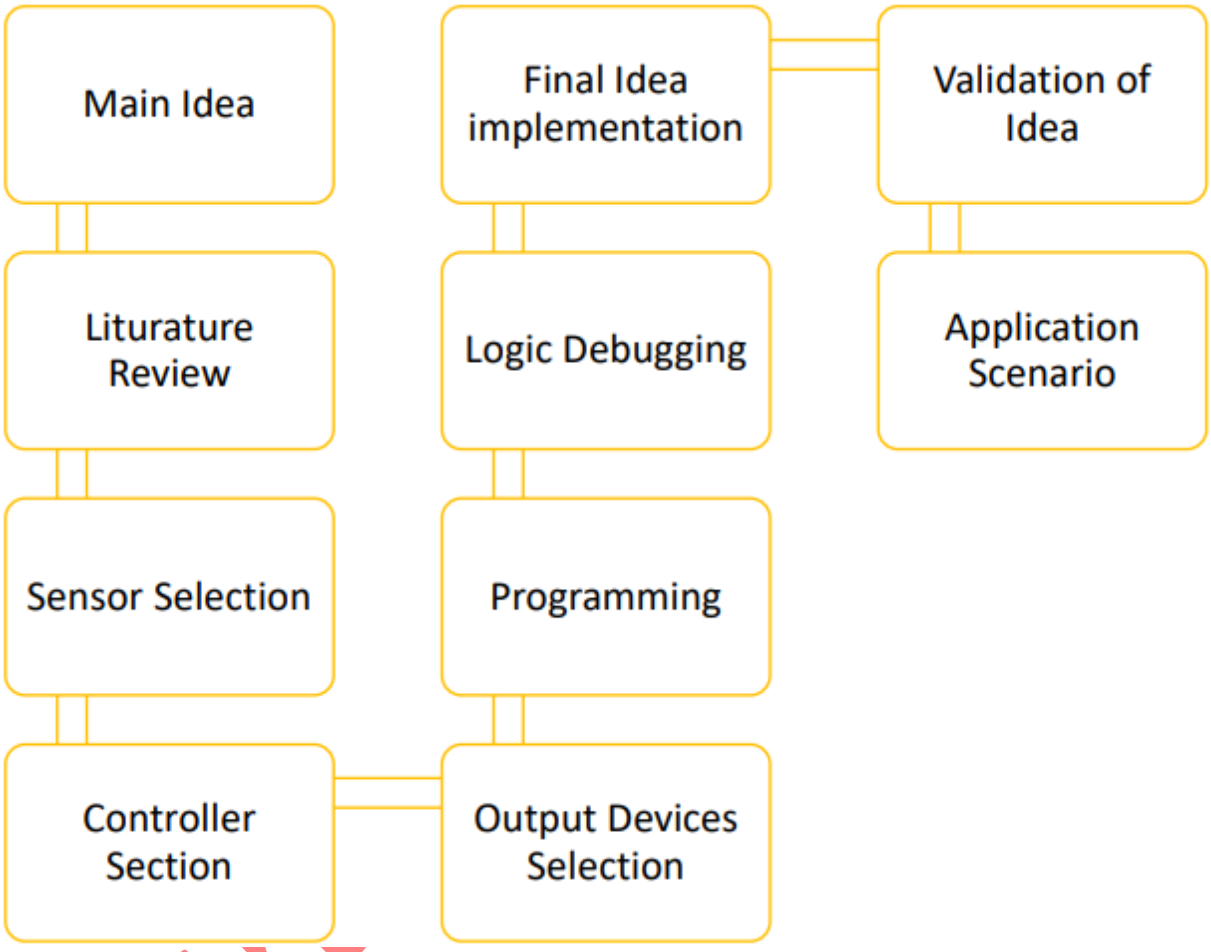
[CE 2.9]I set the module with an external antenna and obtaining location accuracy even in bad weather conditions. I utilized the XBEE module for establishing the wireless communication link among the display modules and train at a defined platform. I specified the XBEE which came with a wireless communication range of 2km and these modules were expensive but mainly borrowed from the university. There were various digital pins used in the XBEE module along with analog pins. There was an associated version and serial communication was obtained among controller and XBEE. I obtained the diagram for wireless communication among two XBEE. I implemented the controller for taking assistance with the serial communication and shared the data wirelessly via air. I selected the XCTU software which was utilized for configuring the XBEE in the router and obtaining the coordination with mode to mode communication occurred among two XBEES.The XBEE communication link block is below:



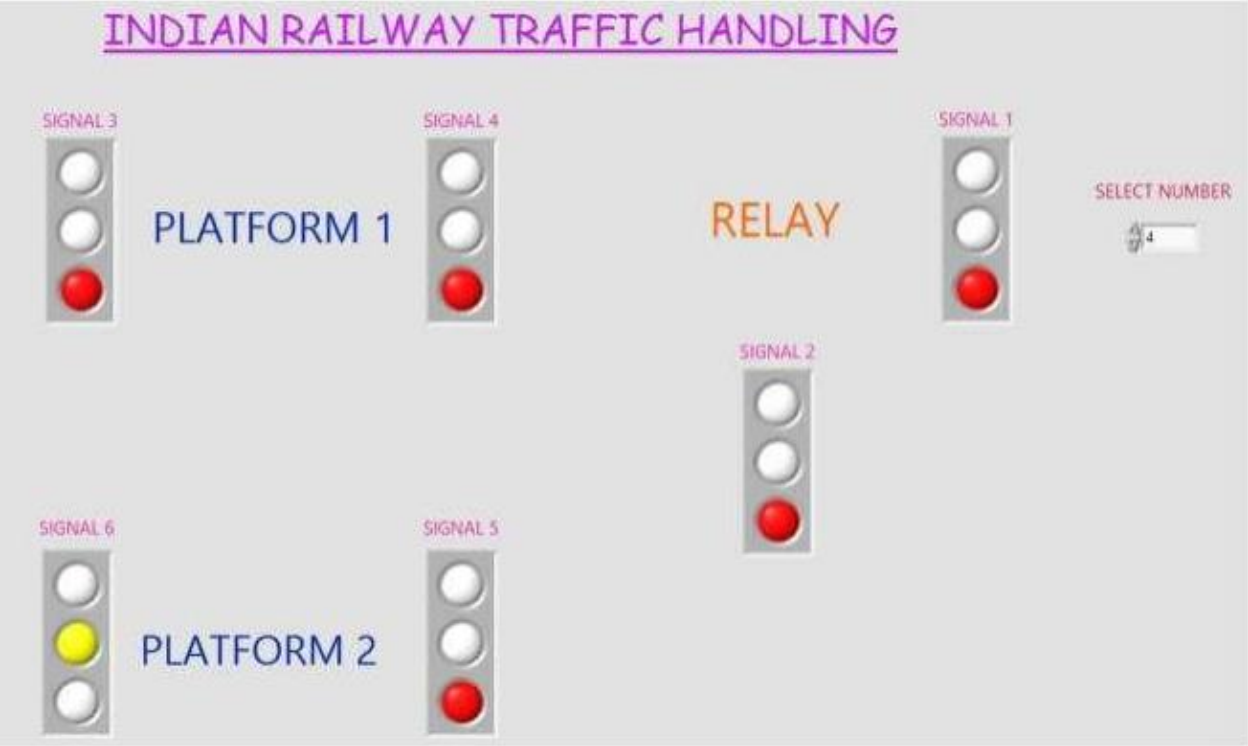
[CE 2.10]While implementing the project, I considered the train safety which worked as an important parameter at any time and each train was carrying thousands of passengers at the specified time. I considered accelerometer for checking the accident scene if happened at any time. I used the sensor for fastening the emergency assistance process by sending SMS to the control room in an automatic manner. It was executed in case if the compartment was out of track. I used the accelerometer sensor which was provided with 3 axis data information for obtaining the analog voltage variation. I then fed the voltage to the Arduino analog input and the voltage value was compared to the threshold voltage. There was the generation of an alarm if the threshold voltage was out of range and sent a message to the control room. I analyzed the reason for sending a message to the driver which was based on catering to the compartment in case of failure.

[CE 2.11]I demonstrated the management and communication skills with proper work planning associated with decent communication among the project mates. I initiated the working with the appropriate planning and literature review conducted accordingly which provided adequate and clear ideas regarding the requirements and responsibilities of the project. After making the selection of the sensor, I implemented the design activities with the output and controller devices. I then forwarded the project towards the programming stage and all sensor controllers along with

output devices were selected after datasheets reading. I led the team and directed the team to obtain concise information regarding the selection of each parameter at the work implementation time. I did individual component programming with IDE which provided optimum understanding and excel towards problem-solving skills. I then executed the idea and validated the consideration with the implemented proposed block diagram.



[CE 2.12] I used the module which was specifically for emergency scenario handling. In an emergency case, I was required to provide a failsafe system in which the system failure was contacted to the control center and the emergency button was provided on the train which was pressed in case of an emergency. It assisted well in reaching the control center along with the nearby stations. I used the GUI module in Labview software which was introduced in the project and the GUI worked for defined signaling concept. I selected the signal manually and controlling was done accordingly. I set RED signal for stopping the train and GREEN was for train operation. However, yellow was for slow down the train. I realized that all signaling mainly dependent on the number of trains on the running track.



D) Summary

[CE 2.13] I implemented the project which worked as the three fields' combination and these were wireless communication, electronics, and signaling & switching for the railway system. Thus, while executing the project activities, I accomplished the project goals and obtained the results accordingly. I executed the project in real-time and the railway system was highly secured with more advanced features that were achieved using the electrical and electronics engineering skills.

Career Episode 3

Wearable Digital Goniometer

A) Introduction

[CE 3.1]

Title: Wearable Digital Goniometer

Duration: [Date] – [Date]

Location: Gujarat, India

Organization: Government Engineering College, Gujarat, India

Position: Electrical & Electronics Engineering Student

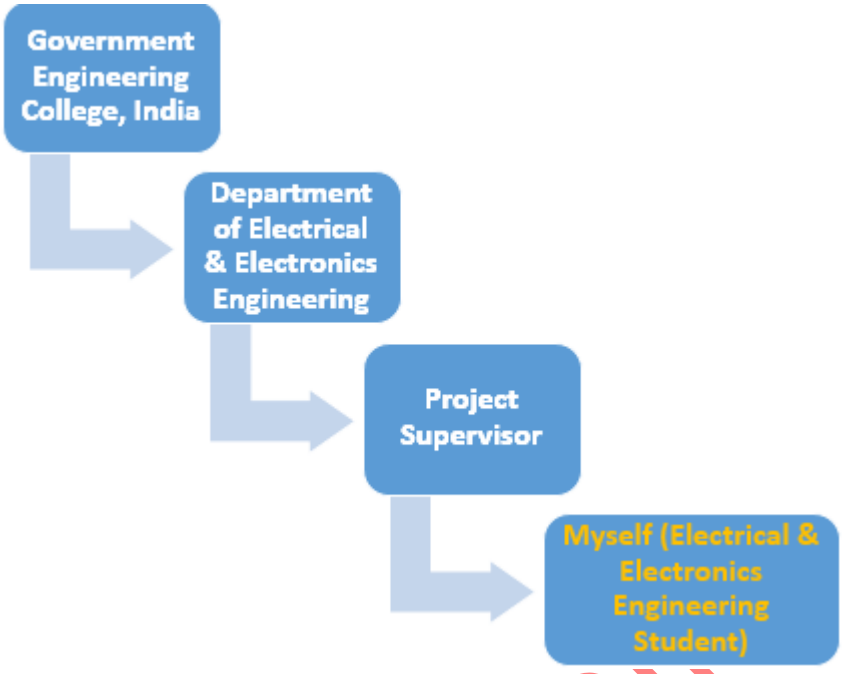
B) Background

[CE 3.2] Presently, the goniometer utilized in the hospitals and mainly utilized as an analog goniometer. The designing of the wearable digital goniometer was done utilizing an accelerometer and it provided optimum result in angle along with the designing in a manner that it typically was wearable for the person. The usage of the multi-accelerometer for human GAIT phase detection was done and finding applications related to robotic and clinical research. The detection of the GAIT phases from accelerometer data was executed for distinguishing among the swing and stance phases.

[CE 3.3]The work aim was the qualitative design of the wearable digital goniometer and the inertial sensor was developed. I conducted the human lower limb quantitative dynamics analysis utilizing wearable sensor systems for measuring various angle and detecting the gait pattern during walking. I incorporated the three-axis accelerometers in the wearable sensor system. I attached the former attached on the foot surface, shank, and thigh for measuring each segment angular velocity. I utilized the latter for measurement of the attached leg segment inclination in every recalibration human motion cycle.

[CE 3.4] I worked on the system for obtaining the results and evaluated the orientations related to human lower limb measurement orientations along with reaction forces for human dynamics analysis. The obtained results were implemented to utilize wearable sensor systems. I measured the joints angles with goniometer assistance. I measured the lower limb angle in patient walking pattern and it was utilized for paralyze person to know the angle improvement.

[CE 3.5]



[CE 3.6] Project responsibilities:

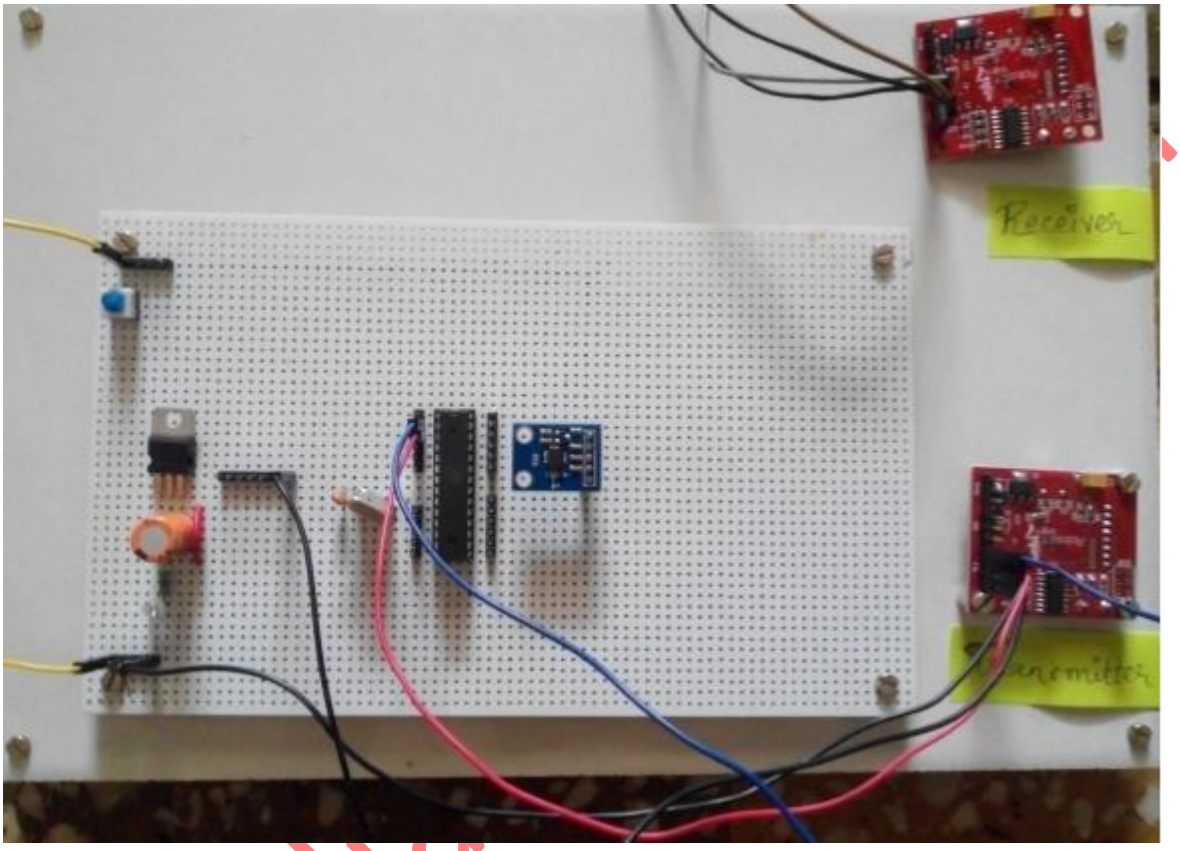
- I utilized the transmitter module which took serial input and did signals transmission from RF.
- I analyzed the limb advancement mainly executed with the movement of the leg.
- I did information transmission during setting the GAIT pattern mainly transmitted in a wirelessly.
- I utilized the transmitter and it executed the working based on serial data received from encoder.

C) Personal Engineering Activity

[CE 3.7]I maintained the initial contact with the starting phase which included the moment when the foot touched the floor. I presented the joint postures at the defined time mainly for determining the pattern of the limb's loading response. I worked on the loading response which worked with the double stance period and the phase initiated with initial contact of the floor which continued until the other specified floor lifted for carrying outswing operation. I executed the midstance in which the initial half single limb support interval worked with the advancement carried out over the stationary foot from angle dorsiflexion.I analyzed the terminal stance which worked with the single-limb support. It was initiated from the heel rise and continued until the other foot strike to the ground. There was advancing of the limb over the forefoot rocker and body weight moved forefoot ahead. I executed the terminal swing which included swing initial phase mainly attained with the vertical tibia and ended with the floor foot strike. I analyzed the limb advancement which worked with the leg moved ahead of the thigh. The limb advancement in this phase was completed from knee extension and the hip specifically maintained the flexion with ankle remained flexed to neutral.

[CE 3.8]I used an accelerometer for the measurement of various angles that occurred during the varied GAIT pattern. I put an accelerometer on the lower end of the knee with the provided12

controller for various knee angles measurements. It was specifically for angle measurement initialization. Furthermore, I utilized two accelerometers for the entire lower limb measurement, and the acquired data from the accelerometer were then transmitted via the RF module to the PC. I displayed the data on the LCD screen and the person complete data would send to the doctor for knowing the person actual condition.

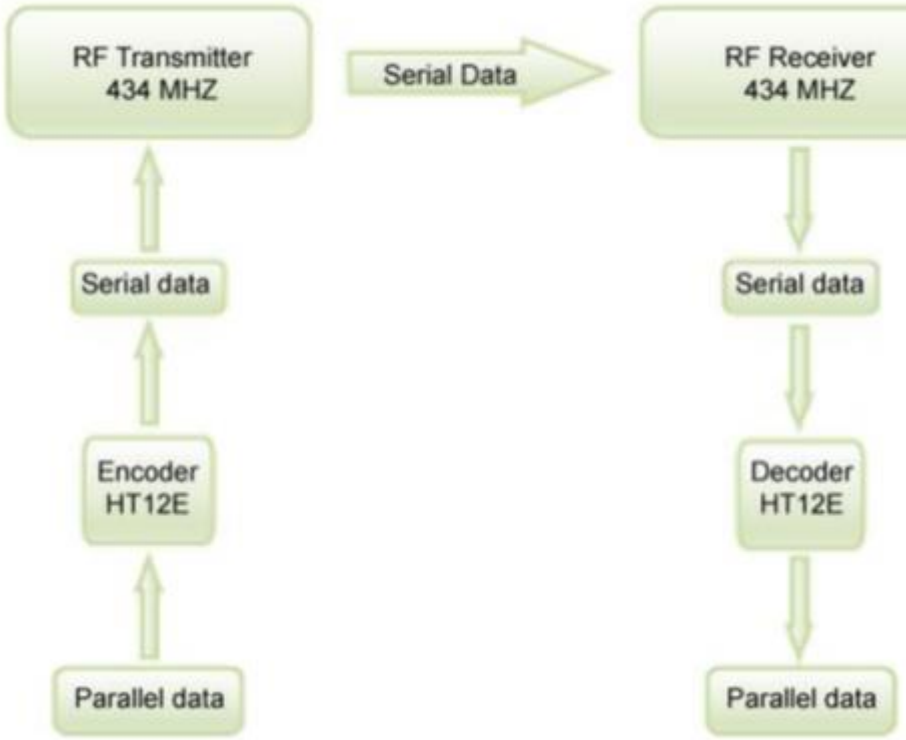


[CE 3.9] I implemented the system block diagram as below:

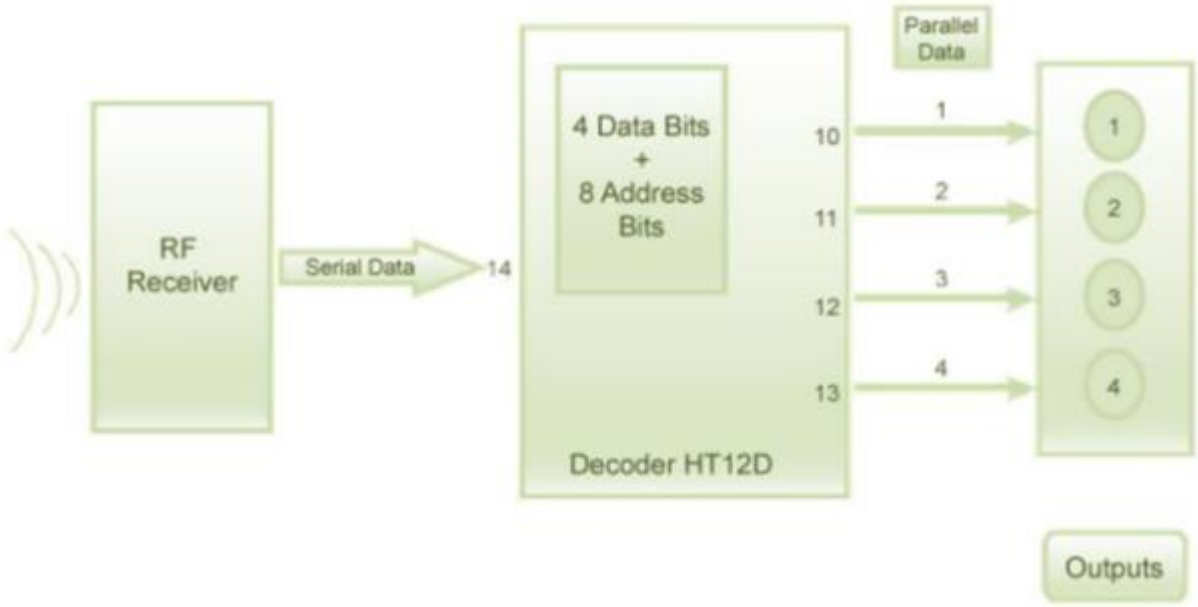
I implemented the system which mainly utilized angles for lower limb and these were executed with connecting the accelerometer sensor with AVR controller for carrying out patient's condition monitoring of various lower limb angles. I executed the design which was a low-cost accelerometer dependent on the goniometer for measuring the lower limb angles with obtained LCD output. I transmitted the information during the GAIT pattern which was transmitted wirelessly.

[CE 3.10]I employed the radio frequency transmission system with the transmitter/receiver operational pair at 435MHz. I used the transmitter module which took serial input and transmitted these signals from RF. I received the transmitted signals from the receiver module and it was then placed away from the transmission source. I executed the system which allowed one-way

communication among two nodes and these were reception and transmission. I implemented the RF module which worked with a four-channel encoder/decoder set and both were selected according to specified standards. I set the encoder which mainly converted the parallel inputs into signals serial set and these signals were for transmission of data from RF to the reception point. I utilized the decoder after the RF receiver for decoding the serial format and retrieved the original signals as outputs.



[CE 3.11]I used Encoder which received parallel data in the control bits and addresses bits format. I selected the control signals from the remote switches which were integrated with 8 address bits and it mainly constituted the 12 parallel signals set. I worked on the encoder which encoded the parallel signals into serial bits and transmission was enabled from providing the ground to pin14. I sent the control signals at defined pins and the serial data was fed to the RF transmitter via pin 17. I used the transmitter which worked upon serial data receiving from the encoder and transmitted it wirelessly to the RF receiver. After receiver receiving the signals, the data was sent to the decoder IC via pin2. I received serial data at the data pin and the decoder retrieved the original parallel format from the obtained serial data.



[CE 3.12]During testing, when there was no signal received at the data pin, it remained set to standby mode and consumed little current for the 5V voltage. It worked when the DIN pin mainly received from the receiver. The oscillator got activated on signal reception and IC decoded the serial data which later checked the address bits thrice. When the bits matched with the local address pins, it led towards putting the data on the data pins and made the VT pin 'high'. I connected an LED to the decoder VT pin and the LED worked for indicating the valid transmission. It resulted to generate the corresponded output at the decoder IC data pins. I sent the signal from lowering the pins and the corresponded signal was received at the receiver's end. Furthermore, I configured the address bits with the usage of the initial 8 encoder and decoder pins. I sent the specific signal and address bits were encoded and decoded. I properly configured the address bits and a single RF transmitter was utilized for controlling various RF receivers of the same frequency. I transmitted 12 data bits for summarization and it consisted of 4 data bits and 8 address bits. I used the signal which received signal at the receiver's end and it was then fed to the decoder IC.

D) Summary

[CE 3.13] I implemented the wearable digital goniometer which was the device for measuring various angles in the human body. I utilized the sensor which provided adequate human motion data. For overcoming the issue, I developed the wearable digital goniometer which was utilized in rehabilitation as it was wearable. I concluded that the wearable digital goniometer utilizing accelerometer overcame the issue in the analog goniometer and it provided optimum data accuracy mainly attained from various joints. I measured the lower limb angles from wearing the device with ADXL335 on the knee and RF was utilized for data transmission to the system. My knowledge in the field of Electrical and Electronics Engineering boosted adequately with the work activities accomplishment.

PROFESSIONAL ENGINEER
Summary Statement

These are the competency Units and Elements. These elements must be addressed in the Summary Statement (see Section C). If you are applying for assessment as a Professional Engineer, you will need to download this page, complete it and lodge it with your application.

Competency Element	A brief summary of how you have applied the element	Paragraph number in the career episode(s) where the element is addressed
PE1 KNOWLEDGE AND SKILL BASE		
PE1.1 Comprehensive, theory-based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	I accomplished the underneath projects in the Electrical & Electronics Engineering field: • Analysis of IoT Node Performance in Internet of Things • Highly Secured Traffic Management System • Wearable Digital Goniometer	CE 1.4, CE 2.3, CE 3.3
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics and computer and information sciences which underpin the engineering discipline	I worked on carrying out an analysis on various project factors and achieved the work results within the set work timeline.	CE 1.6, CE 2.7, CE 3.7
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	I applied technical knowledge in carrying out in-depth analysis and achieved the project resutls within the set work timeline.	CE 1.7, CE 2.8, CE 3.9
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	I conducted research on various factors and obtained the project resutls with the adequate research being conducted on numerous factors.	CE 1.12, CE 2.12, CE 3.10
PE1.5 Knowledge of contextual factors impacting the engineering discipline	I worked on evaluating the project factors and getting the project results within the set timeline.	CE 1.11, CE 2.11, CE 3.12
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the specific discipline	I made significant research regarding the project norms and principles which were accomplished within the set timeline.	CE 1.9, CE 2.10, CE 3.11

PE2 ENGINEERING APPLICATION ABILITY		
PE2.1 Application of established engineering methods to complex engineering problem solving	I established the work principles and obtained the resutls within the set work timeline.	CE 1.12, CE 2.11, CE 3.9
PE2.2 Fluent application of engineering techniques, tools and resources	I evaluated the work factors and implemented fluent engineering concepts for obtianing the defined project resutls.	CE 1.10, CE 2.9, CE 3.8
PE2.3 Application of systematic engineering synthesis and design processes	I made systematic research on numerous work factors and achieved the project results within the specified project.	CE 1.7, CE 2.10, CE 3.9
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	I worked on carrying out the systematic research within the defined work timeline and obtained the associated work results.	CE 1.10, CE 2.8, CE 3.11
PE3 PROFESSIONAL AND PERSONAL ATTRIBUTES		
PE3.1 Ethical conduct and professional accountability	I made work activities implementation which was linked with the required objectives and achieved the work results within the set timeline.	CE 1.9, CE 2.10, CE 3.9
PE3.2 Effective oral and written communication in professional and lay domains	I executed the research and achieved the results within the set work timeframe with the consistent effective oral and written communication skills.	CE 1.12, CE 2.11, CE 3.8
PE3.3 Creative innovative and proactive demeanour	I did proactive demenour execution with the creative skills applied efficiently in the project.	CE 1.8, CE 2.9, CE 3.10
PE3.4 Professional use and management of information	I researched on the work factors with the professional utilization of the technical skills and information management skills were applied within the defined timeline.	CE 1.11, CE 2.12, CE 3.11
PE3.5 Orderly management of self, and professional conduct	I applied the self-management skills which was based on various factors and obtained the desired results.	CE 1.7, CE 2.8, CE 3.8
PE3.6 Effective team membership and team leadership	I made effective usage of the team membership skills throughout the project tenure.	CE 1.10, CE 2.12, CE 3.12