READING ASSIGNMENT

IoT SMART LIGHTING, INTRUSION DETECTION AND REMOTE PATIENT HEALTH MONITORING

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ECE 442

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Acknowledgment: I acknowledge all of the work (including figures and codes) belongs to me and/or persons who are referenced.

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[1]

The Energy-Aware Wireless Sensor Network with Ambient Intelligence for Smart LED Lighting System Control was a project made by the Nanyang Technological University. The goal was to design an intelligent system that will control the indoor lighting of a residential or commercial building while saving the most energy possible and also satisfying the user's preferences. Buildings are now growing everywhere and the lighting system constitute 26% of the total energy consumption of those buildings which is why this system will be highly wanted in all buildings. The system will consist of:

- 19 distributed wireless sensor nodes
- 1 base station node
- 17 end device nodes
- 1 range extender node
- Personal computer
- Digital addressable lighting interface controller
- Led lighting array

The wireless sensor nodes will communicate among themselves to control the different Leds. The luminance will be measured by a light dependent resistor and the motion will be detected by a pyroelectric sensor. They will all communicate which other allowing to dim the Led according to the users preferences. The personal computer will be in charge of the program of that implement the closed-loop approach to control the light intensity of the LED and the adjust the ambient light system. The led lighting array system was used because it easily to implement in any building settings already in service. The implementation of the energy aware wireless sensor network fall on one aspect which is the operational lifetime. Their experiments show that using the internal timer of the microcontroller increased the operational lifetime of the wireless system by 20%. This system is then able to optimize the light intensity and energy saving to meet the satisfaction of every consumer.

[2]

The Smart indoor Solid state lighting was a research done by Sachin Bhardwaj, Tanır Özçelebi, Richard Verhoeven, and Johan Lukkien. The smart indoor SSL has for goal to control the illumination of an indoor space according to the user activities and preferences. One simple factor would be a basic ON/OFF mode if the user is not in the room and the complex approach would be to dim the lights according to the type of activity the user is preforming in the room per example taking a picture will require a good luminosity while reading a book or watching tv would require another level of intensity based on the user preferences. The illumination model would be based of two parts, the LED luminary and light sensor placement and the illumination control algorithm. The LED luminary is just an array of LEDs with an arbitrary shape rectangle, triangle or square. After analysis, the implemented approach will be achieved by implementing an LED array luminaries illuminating square grids and will run a smart SSL system. The illumination control algorithm will be based on the user preferences for a given activity. The led brightness levels will be adjusted dynamically to control the illumination in the activity space. The LEDs will work together to provide the required illumination in their corresponding girds.

The implementation of this system will be done on a flexible structure called Open Service Architecture for Sensors (OSAS) for sensor network. After a series of experiments, the results shows the proposed smart LED lighting system will be able to achieve the target illumination levels in a square grid. In each square gird the smart, one LED will be in charge of the illumination of the surface below. The proposed approach could be enhanced of course by providing multiple users control per activity space. The system will take in consideration multiple users preferences and will set the illumination according to the most desired preferences in order to achieve a working environment that will be suitable to all users.

[3]

Open remote is a system that provides solution for:

-For a smart city:
Whether it is crowd control, public safety, or adaptive lighting, OpenRemote can assist in monitoring and integrating different systems in public spaces and enhancing citizen participation. Giving experts, area managers and visitors insight and control over their environment.

-Buildings:
Managing and integrating your building systems, from climate control and power management, to lighting and security into one system, adding individual user control, as well as tailored dashboards for facility management and maintenance. OpenRemote offers the flexibility to do all of that with one solution

-Home Automation:
Manage your scenes comfortably in your living room, combine lighting ambiance and climate. Set the scene with the press of a single button. OpenRemote enables you to connect virtually all types of devices within your network and create an intuitive universal remote on your tablet or smartphone. Or do without a UI and automate everything using Rules.

-HealthCare:
To assist people at home or support rehabilitation, OpenRemote offers control of your space even with just a blink of your eyes. Rules and messaging make independent living a reality. The solution can grow over time as the requirements change
It utilizes in an open source code so that anybody can contribute to the project and the climbs the echelon from contributor depending on your contribution to their project.

[4] http://www.nest.com

Nest home is a system that has for mission to create a home that takes of people inside it and the world around it.
Nest now works with google built in to help make your environment secure and comfortable.
Nest dispose of a variety of products inside your home:
-Nest hello video doorbell:
This system replaces your typical doorbell and let you see who is in front your door 24/7. It now has integrated google which by the phrase “ Hey google, show me who is at the door” will give you a live recording of the door from anywhere up to 3 hours back.

-Nest cam indoor:
Simply allows you to see what is going in your house from any devices whether you are in an another room or away and is equipped with 1080p HD.

-Nest learning thermostat:
It is simple to use and learns what temperature you like and build a schedule around yours. Their slogan “ It pays for itself” just implies that it will help you save on avg 12-15% on heating bills and 15% on cooling bills.

-Nest IQ cam outdoor:
It is not simply a camera that let you see what is going on outside. Wheter you are watching or not it will alert you from any person trying to walk by your house for up to 50 feet and will send you a picture of that person.
Nest has great products and really focus on the users by now having google integrated so that you only need to ask and receive.
These products would also be perfect in a business setting that would let the owner aware if everything by crating a secure environment.

[5]

The project IoT-based Appliance Control System for Smart Homes was designed by Ming Wang, Guiqing Zhang, Chenghui Zhang, Jianbin Zhang, Chengdong Li. They wanted to create an IoT for all the appliances in house to control manage and save on electricity bills while including also a security system. The smart control system will use a smart central controller to set up a radio frequency of 433MHZ wireless sensor and actuator network (WSAN). To make it user friendly it will utilize client computers smartphones and tablets via WIFI.
The system can be divided in two parts:
-The upper part: wireless router, computers tables and smart phone will control the system via internet
-The lower part: Smart central controller, switch modules, RF modules, adjusting modules, environmental modules, data collectors.

First, all the control modules was designed into standard sizes to be put easily in walls. Secondly, The smart central controller and all these modules make up of a WSAN, which make it need no extra wiring. Thirdly, the smart home control system keeps a dynamical balance through self-configuration and self-organization. Fourthly, the smart home control system is easy to set up and maintain.
The smart home information system will be running on the server computer and will have a login for security purposes that will give you access to all the appliances of the house giving you real time data and graphs of every single one of them.
They created a really nice user friendly interface that is facilitating the interaction with users:
-Light, air conditioner, curtains, door lock and valve in every room.
In future work, they will improve the energy efficiency to lower energy cost and reduce emissions.

[6]

The Cloud controlled Intrusion Detection and Burglary Prevention Stratagems in Home Automation Systems was an idea from Anindya Maiti and S. Sivanesan at the School of Computing Science & Engineering in Vallore india. They wanted to implement and design, an operation of a cloud connected adhoc wireless home automation system with en suite intrusion detection and burglary prevention stratagems. The home automation system will be equipped with improved infrared cameras that will give real time data of the security system. If there happens to be an intrusion the system will alerts the user via SMS and he will able to monitor from anywhere. The user will also have the option to alert his neighbors that are using the same home security system and even report it to the police. They realized a demo of the project, it uses a wireless network 802.11n to create an ad-hoc network with adequate signal range to operate accorss the house. The home appliances are plugged into the AC power output controlled by a microcontroller via relay.
The home security system is equipped with a wide angle camera, implemented in every single room that will detect the intrusion and will communicate via the cloud to alert the user.
The following will be the steps taking in case of an intrusion:
-intrusion detected
-report intrusion to the cloud
-notify user via sms
-user seeks for real time surveillance views
-Output from cameras accessible through the cloud by the user
-user checks the status of the every room
-confirm or not intrusion
-if confirmed alert neighbors
-inform the police
-rings alarm bell sound
It has a good potential overall from the low cost to the ability of alerting the police and the neighbors.

[7]

The intelligent Intrusion Detection System Based on UPnP Technology for Smart Living was an ida of Mong-Fong Horng , Bo-Chao Chang , Bei-Hao Su from the national university of Applied Sciences in Kaoshiung Taiwan. This intrusion system will be equipped with PDA's that may alert the intrusion to the user locally or remotely locally with captured images of the subject. IPP will be used to recognize and identify the intruder and UPnP will serve for the instant alert with 90 to a 100% of accuracy.
The UPnP works as follow:
-Addressing: The addressing of UPnP devices is to obtain their unique IP addresses. It usually is done by DHCP servers or Auto-IP.
-Discovery: On the entering of devices to a service area, the devices issue a broadcasting SSDP notification to the other devices existing in this area. Via this broadcast message, CP will be aware of the statuses of the existing SP and RP and control them.
-Description: All messages exchanged between CP, SP and RP are presented in XML syntax. The exchange of XML messages is implemented by HTTP protocol.
-Control: Control actions are issued by CP to either SP or RP. CP uses control actions to select the content server and the preferred content and the specific RP as the player to render the content according to user instructions.
-Eventing: The eventing is used to notify the related devices when the status of a device is changed. For example, an eventing of content run-out will be sent by RP to CP when the replaying of a media clip is ended.
-Presentation: RP is in charge of service content presentations. For examples, in multimedia service, RP is the media player to replay the media; and in home appliance control, the power switch is the RP to realize the desired output of users.
The UpnP will alert the user via text messaging and will report the pictures taken of the intruder.
The system is very convenient, reliable and accurate.

[8]

The Development of Multipurpose Gas Leakage and Fire Detector with Alarm System is an idea by Nivedhitha S , Padmavathy A P , Susaritha U S Mentor: Dr. M. Ganesh Madhan from the Madras Institute of Technolgy in Chennai.
The system has a simply purpose which is to upgrade our usual fire prevention system with a smart one that will use Leds to show the concentration of gas in the room. The system should also be able to send an audio alarm to the user and also display data on a computer screen.
The system will be equipped with:
-MQ-6 LPG sensor
-MOC 7811
-Wireless transmission range
-Transceiver CC2500
-Computer Display
-Potentiometer
-LEDS
-Buzzer
-Power supply
-Relay
It integrates two sensors to detect gas and smoke level and gives visual indication by using simple LEDS>
When the condition are met and the parameters are high it will send an audio alert throughout the house.
The system could be added to the fire station alert system so that in case of fire they could be there as soon as possible.

[9]
The Patient Centered Real-Time Mobile Health Monitoring System was project made by Professor Won-Jae Yi and Professor Jafar Saniie from the Department of Electrical and Computer Engineering at Illinois Institute of Technology. They wanted to create a medical device (PCMHM) which means patient centered mobile health monitoring system to determine the patient's health information in real time. You could track all your vital information and it also would include a fall detection system.
The design has 4 major parts:
-Wireless sensor Node
-A central database server
-An android smartphone app
-W-iPCN central node
In Terms of sensor they planned on using body sensors to get the vitals out of the body.
-A sensor for the blood pressure
-A pulse Oximeter
-Temperature sensor
-Respiration sensor
-Glucose sensor
-SpO2 sensor
-EEG
-ECG
-EMG
-Accelerometer
-Gyroscope
-Barometer
-Contactless IR
-Magnetometer
-Humidity
-GPS
They implemented the system for health monitoring on a standard Android smartphone. The system will not only be able to detect any anomalies but will also have a fall detection for elderly that will able to send alerts and notify the emergency contact that the user needs assistant immediately. It will be able to detect that the cause of the fall by getting data from the sensor.

[10]

The Energy Harvesting Technologies for Structural Health Monitoring Applications was an idea of Changki Mo and Joseph Davidson from the School of Mechanical and Materials Engineering at Washington State University Tri-Cities Richland. The need to be able to monitor the behavior in health machinery and structures is growing. In order to do that you would need wireless communication, embedded sensors, data acquisition and also an energy harvesting systems. This paper will focus on the harvest technology which is going to be powering the entire health monitor 24/7 whiteout human intervention if the structure is rich enough loading. The resources that would be utilized by the system will be coming from ambient energy sources like vibration, thermal gradient, sun , wind and pressure.
Vibrations: Typically, the electrical energy is generated by applying strain energy from the vibrations to a piezoelectric material, which become electrically polarized when subjected to strain, or to displace an electromagnetic coil
Wind: It will work like a micro-wind turbine to power the wireless sensor.
Thermal Energy: Another method is the use of thermoelectric generators, it is a good system with no moving parts.
Solar energy: Solar energy harvesters have also been applied to wireless sensing nodes for structural health monitoring.
This is a great project and harvest energies are the future.

[11]

The Environmental Effect Removal Based Structural Health Monitoring in the Internet of Things was an idea by Hongyang Zhang, Junqi Guo Xiaobo Xie, Rongfang Bie, Yunchuan Sun from Beijing Normal University in China. They wanted to create an IoT based system for structural health monitoring. This SHM system is going to bring a new factor to the table. This system is going to remove environmental conditions that could play with the datas coming from the SHM. After removing environmental effect, HHT will be used for analysis and monitoring. One of the biggest issues in architecture right now is being able to detect and locate an issue in a building as fast as possible. The building will be equipped with a lot of sensors throughout the building to be able to detect accidents and problems.
Due to the size of these structures they will be more or less likely to be exposed to environmental problems that will cause to give wrong reading to the sensor. Principal component analysis (PCA), which is a multivariate statistical method, performs as a proper orthogonal decomposition. Up to now, PCA has been widely used in structural health monitoring. In this paper, they used PCA to identify the linear mapping relationship between unobservable factors and features.
This requires measuring the vibration data from an undamaged structure during a period of time (i.e. several months). The structural features can be extracted from the raw data.
Then it will be applied the environmental data recorded on the building will be then removed from the sensibility of the sensors.
This paper proposes an effective method for structural health monitoring in wireless sensor networks. Sensors are used for real-time sensing and monitoring of architectural or mechanical structures. Principal component analysis (PCA) is utilized to eliminate environmental interferences from sensor data which contain both real vibration feature of structures and environmental effects.

[12]

The Energy-harvesting WSNs for structural health monitoring of underground train tunnels was an idea of Alessandro Cammarano, Dora Spenza and Chiara Petrioli from the Department of Computer Science at Sapienza University of Rome in Italy.
They wanted to create a structural health monitoring system for underground tunnels because of how difficult it is to monitor the structure of the tunnel 24/7 without human intervention. SHM is a vital tool to help engineers improving the safety of critical structures, avoiding the risks of catastrophic failures, Also WSN is a very friendly system and can be used as early as possible in the building stages of the tunnel. People have restrained themselves from using WSN because of the lifetime reliability and also the energy consumption of the system. Therefore they decided to implement the harvest energy to overcome the energy bottleneck suffered by traditional WSNs, thus removing the limits that make current WSN-based monitoring systems unfit for SHM applications. They collected data from a tunnel of the new Rome Underground Metro B1 line and during the post-construction testing phase of the tunnel. They instrumented 220m of tunnel with six Telos B motes equipped with wind micro-turbines, which collected air-flow data generated by passing trains for 33 days.
The preliminary results are promising and confirm the feasibility of long-lasting, environmentally-powered wireless sensor network systems for structural health monitoring in underground train tunnels

[13]

Wireless Sensor Network for Structural Health Monitoring using System-on-Chip with Android Smartphone was an idea of Pr.Won-Jae Yi, Spenser Gilliland and Pr. Jafar Saniie from the Department of Electrical and Computer Engineering at Illinois Institute of Technology in Chicago.
Buildings require constant observation by humans in order to detect in any problem within the infrastructure.
The system made will able to improve inspection productivity, increases mobility, and allows the aggregation of critical data to enhance inspection accuracy.
The system was based on Reconfigurable Ultrasonic System-on-chip Hardware (RUSH) platform. RUSH collects and analyzes ultrasonic data to detect structural flaws such as cracks, voids, or fatigue. The collected data is then transferred through a Bluetooth transceiver to an Android smartphone referred to as Mobile Sensor Data Collector (MSDC).
The system used three different types of sensors that can be useful for the structural health monitoring. As an example, they examined a steel block for flaw detection by applying the SSP algorithm to the ultrasonic signal. Acquired data is analyzed on RUSH and transmitted to MSDC using the Bluetooth transceiver. Accelerometer and temperature sensor are also acquired using MSDC. MSDC plots the received sensor data on the screen of the smartphone, and simultaneously transmits to a central server.
It is overall a good system, very efficient and robust.

[14]

The Wireless Sensor Networks for Early Detection of Forest Fires was an ida of Mohamed Heddefa and Majid Bagheri at the School of computing Science at Simon Fraser University Canada. This system will be able to predict risk of fires in forest as early as possible. This system is backed by a lot years of research on fires in forest. The research were meant to analyze the past fires that happened and to determine the different weather components that resulted in the realization of those fires. They made a simple data aggregation scheme based on the FWI System. This data aggregation scheme significantly prolongs the network lifetime, because it only delivers the data that is of interest to the application.
The fire weather system is composed of 3 levels:
-Fire weather observations
-Fuel Moisture Codes
-Fire behavior indexes.
The fire weather observations include: Temperature, relative humidity, wind, rain
The fuel moisture codes include: Pine Fuel, Moisture Code, Duff moisture code and Drought code
The fire index behavior include: Initial Spread, Build up.
They used a k-coverage algorithm to solve the k-coverage problem. The algorithm is simple to implement and does not require any specific node deployment schemes. Therefore, nodes can be uniformly deployed by, for example, throwing them from a plane. This significantly facilitates node implementation in forest. They also presented a data aggregation scheme based on the FWI System. They showed through simulations that our algorithm balances load across all deployed nodes, and therefore maintains reliable coverage and significantly prolongs the network lifetime.

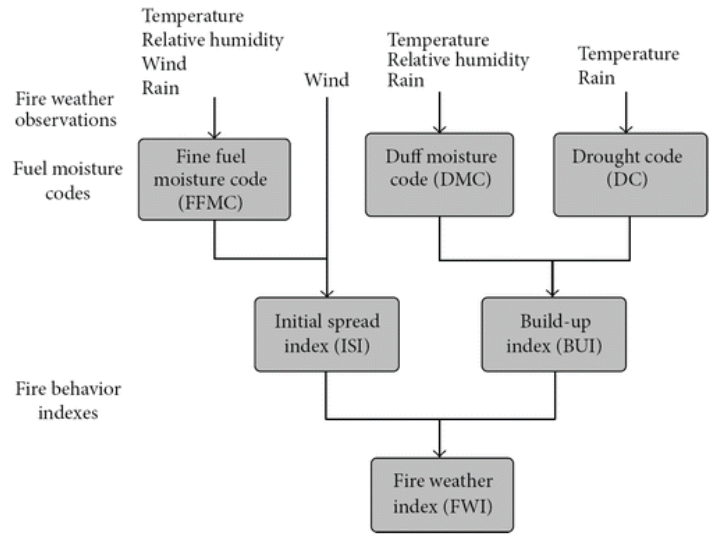
[15]

The Novel Accurate Forest Fire Detection System using Wireless Sensor Networks was an idea by Yongsheng-Liu, Yu Gu, Guoleng Chen, Yusheng Ji and Jie Li from the University of Tsokuba in Japan. They designed a system that will be able to detect fires in forests. The multi-criteria detection was implemented by the artificial neural network which fuses sensing data corresponding to multiple attributes of a forest fire into an alarm decision. They also implemented a solar battery that will consistently give power to the sensor node that will be deployed in the forest.
The system will work as follow:
The multi-criteria detection is introduced to WSNs to increase the detection accuracy of a forest fire.
The artificial neural network is adopted to fuse sensing data corresponding to multiple attributes of a forest fire into an alarm decision.
The prototype of the proposed system and the solar battery capable of persistently powering sensor nodes deployed in the forest have been developed.
The detection accuracy of the system will be tremendously increased by the multi-criteria etwork.
It is a good system and testing showed that the prototype triggered a fire alarm with high accuracy.

PART B

To design the home automation systems including smart lighting, intrusion detection and remote patient health monitoring system and also to design the structural health monitoring system The IoT level 5 will be the perfect match.
A level-5 IoT system has multiple end nodes and one coordinator node, the end nodes will perform the sensing and actuation.
The coordinator node collects data from the end notes and sends to the cloud. Data will be stored and analyzed in the cloud and application based.
The level-5 IoT systems are suitable for solutions based on wireless sensor networks, in which the data involved is big and the analysis requirements are computationally intensive.

PART C
b)
The types of data generated by a forest fire detection system are summarized in the diagram below from the Novel accurate forest fire detection system using wireless sensor Networks.



c) The analysis required for fire detection:

The multi-criteria detection is implemented by the artificial neural network which fuses sensing data corresponding to multiple attributes of a forest fire into an alarm decision. Due to the utilization of the artificial neural network, the proposed system enjoys low overhead and the self-learning capability

References

[1] Smart LED Lighting System Control
Attached Files:
[1] Smart LED Lighting System Control.pdf

[2] Smart Indoor Solid State LIghting
Attached Files:
[2] Smart Indoor Solid State Lighting.pdf

[3] Open Remote
visit http://www.openremote.org

[4] Nest
visit http://www.nest.com

[5] IoT-based Appliance Control System for Smart Homes
Attached Files:
[5] IoT-based Appliance Control System for Smart Homes.pdf

[6] Intrusion Detection System
Attached Files:
[6] Intrusion Detection System.pdf

[7] Smart Living
Attached Files:
[7] Smart Living.pdf

[8] Alarm System
Attached Files:
[8] Alarm System.pdf

[9] Remote Patient Monitoring System
Attached Files:
[9] Remote Patient Monitoring System.pdf

[10] Energy Harvesting Technologies for Structural Health Monitoring
Attached Files:
[10] Energy harvesting technologies for structural health monitoring.pdf

[11] Structural Health Monitoring
Attached Files:
[11] Structural Health Monitoring.pdf

[12] Underground Train Tunnels
Attached Files:
[12] Underground Train Tunnels.pdf

[13] Structural Health Monitoring System using FPGA and Smartphone
Attached Files:
[13] Structural Health Monitoring using FPGA and Smartphone.pdf

[14] Early Detection of Forest Fires
Attached Files:
[14] Early Detection of Forest Fires.pdf

[15] Forest Fire Detection System
Attached Files:
[15] Forest Fire Detection System.pdf