MULTIMEDIA COMMUNICATIONS TECHNICAL COMMITTEE
http://www.comsoc.org/~mmc

MMTC Communications - Frontiers

Vol. 17, No. 5, Sep 2022

CONTENTS

SPECIAL ISSUE ON Recent advances in the Internet of Things (IOTs) and it's applications

Guest Editors: [1]Sheng-Lung Peng, [2]Ramasamy V and [3]Subhrajyoti Deb, [4]Valentina E. Balas
[1]National Taipei University of Business, Taipei, Taiwan.
[2]Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology (Deemed to be University),Chennai, Tamil Nadu, India.
[3]ICFAI University Tripura.
[4]Aurel Vlaicu University of Arad, Romania.

This special issue of Frontiers focuses on innovations in Future IoT Communications. The research topics of the papers in this special issue include IoT for agriculture, IoT for healthcare, disaster management using IoT, etc. The Internet of Things is a promising new technology. AI and ML make IoT automation easier. It will benefit healthcare and industry in the upcoming years. IoT will also build a barrier across the internet to protect cyberspace, boosting global growth.

The first paper proposed a model for farm temperature monitoring. The model incorporated micro-ring resonator (MRR) based photonic temperature sensors and connected them via optical fiber to a control unit which is again connected to an IoT cloud server to send real-time data to the end users. Based on the data received from the sensors, the particular heater will get enabled.

The second paper suggests a smart flexible helmet for the workers to provide security and rescue measures in case of any panic circumstances. This helmet is intended to provide constant observation of the labours and to prevent them from any health threats while working. The project's goal is to make construction sites safer and more secure for workers, hence lowering the number of fatalities. To safeguard the worker, the helmet has a variety of sensors. The IoT-based smart helmet is put together by combining all the components into a single helmet. A clever, reasonably priced helmet for the employees is described in the suggested system.

The third paper reviews recent research works on user privacy preservation in iot environments for poi recommendation systems and the literature on their relative performances. This review also includes various limitations of those discussed research works, which can be considered as the basis for future scope in the POI recommendation systems.

Prof. Sheng-Lung Peng is a Professor and the Director of the Department of Creative Technologies and Product Design, National Taipei University of Business, Taiwan. He received the PhD degree in Computer Science from the National Tsing Hua University, Taiwan. He is an honorary Professor of Beijing Information Science and Technology University, China, and a visiting Professor of Ningxia Institute of Science and Technology, China. He is also an adjunct Professor of Mandsaur University, India. Dr. Peng is also a Director of Chinese Association of Public Affairs Management, Information Service Association of Chinese Colleges, Taiwan Association of Cloud Computing, and ICPC Asia Taipei Site; the Secretary General of the ICPC Contest Council for Taiwan; and a Supervisor of Chinese Information Literacy Association, and of Association of Algorithms and Computation Theory, Taiwan. Dr. Peng has edited several special issues at journals, such as Soft Computing, Journal of Internet Technology, Journal of Real-Time Image Processing, International Journal of Knowledge and System Science, MDPI Algorithms, and so on. His research interests are in designing and analyzing algorithms for Bioinformatics, Combinatorics, Data Mining, and Networks areas in which he has published over 100 research papers.

Dr. Ramasamy V is currently working as an Associate Professor in the Department of Computer Science and Engineering at Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology (Deemed to be University), Chennai, Tamil Nadu, India. His area of interest includes Mobile Cloud Computing, IoT, Machine Learning, Data Science, Artificial Intelligence and Data mining. He is the author of several scholarly research papers in international journals andconferences. He is the Organizing Chair of International Conference on Advanced Computing and Intelligent Engineering (ICACIE) and International Conference on Advanced Communications and Machine Intelligence (MICA).

Dr. Subhrajyoti Deb is an Assistant Professor in the Department of CSE at the ICFAI University Tripura, India. Prior to joining the ICFAI University, he was a Postdoctoral Visiting Scientist in the Applied Statistics Unit, ISI Kolkata, India. He has received his MTech and PhD from the NIT Agartala and NEHU Shillong, respectively. His research interests include multimedia security, cloud, and IoT. He is an author/co-author of 25 international publications in refereed journals and conferences. He has organised many sessions at major technical events.

Prof. Valentina E. Balas is currently Full Professor in the Department of Automatics and Applied Software at the Faculty of Engineering, “Aurel Vlaicu” University of Arad, Romania. She holds a Ph.D. in Applied Electronics and Telecommunications from Polytechnic University of Timisoara. Dr. Balas is author of more than 300 research papers in refereed journals and International Conferences. Her research interests are in Intelligent Systems, Fuzzy Control, Soft Computing, Smart Sensors, Information Fusion, Modeling and Simulation. She is the Editor-in Chief to International Journal of Advanced Intelligence Paradigms (IJAIP) and to International Journal of Computational Systems Engineering (IJCSysE), member in Editorial Board member of several national and international journals and is evaluator expert for national, international projects and PhD Thesis. She served as General Chair of the International Workshop Soft Computing and Applications (SOFA) in eight editions 2005-2018 held in Romania and Hungary. Dr. Balas participated in many international conferences as Organizer, Honorary Chair, Session Chair and member in Steering, Advisory or International Program Committees. She is a member of EUSFLAT, SIAM and a Senior Member IEEE, member in TC – Fuzzy Systems (IEEE CIS), chair of the TF 14 in TC – Emergent Technologies (IEEE CIS), member in TC – Soft Computing (IEEE SMCS). Dr. Balas was past Vice-president (Awards) of IFSA International Fuzzy Systems Association Council (2013-2015) and is a Joint Secretary of the Governing Council of Forum for Interdisciplinary Mathematics (FIM), - A Multidisciplinary Academic Body, India. She is also director of the Department of International Relations, Programs and Projects and head of the Intelligent Systems Research Centre in Aurel Vlaicu University of Arad, Romania.

IoT in smart farming for controlling and monitoring temperature using MRR based optical sensor

[1]Suman Debnath, [2]Srikanta Das, [3]Satyabrata Singha, [4]Nitish Sinha, [5]Bishanka Brata Bhowmik, [6]Senthilkumar Piramanayagam, [7]Prasad Mahudapathi

[1,2,3,4,5]Tripura University, India.
[6]Alten-UK, Coventry, England,
[7]IOOF, Melbourne, Australia
[1]suman.ece@tripurauniv.ac.in

1. Introduction:

The Internet of Things (IoT) describes wireless protocols used by objects to communicate with one another without any human interaction. Connections between IoT-capable devices are necessary for IoT technology to transmit the data for various tasks and operations properly. The main objective is to connect physical devices to the internet. The sensors included in the system's parts make it possible to monitor the systems in real-time from a distance using a cloud network. IoT has developed as a pioneering field of research in recent times [1]. With such a large number of intelligent things/objects and sensors/actuators being produced via the Internet of Things (IoT), which will serve as the foundation for future cyber-physical intelligent global automated system design. IoT technology may thus be used in many other sectors, such as health monitoring, manufacturing, retail, home automation, agriculture, and more [2].

As we enter the new era of technological advancement, implementing IoT in agriculture saves our time and helps produce the best livestock [3]. A significant challenge in the modern period is livestock monitoring, primarily because of the rising demand for animal products for the ever-increasing population [4]. IoT technology aids livestock management by sending environmental data of the farm situated in distant locations gathered by sensors through the cloud network to farmers. The circumstances for cattle reproduction are automatically or manually regulated depending on the information. One of the most crucial factors in determining the health and welfare of animals is core body temperature. A fall and rise in body temperature may lead to serious health issues like fever or influenza that may ultimately cause death resulting in a loss in profit [5]. So the farm needs to be well monitored using accurate temperature sensors to gather the data at regular intervals.

In our proposed model for farm temperature monitoring, we have incorporated micro-ring resonator (MRR) based photonic temperature sensors and connected them via optical fiber to a control unit which is again connected to an IoT cloud server to send real-time data to the end users. Based on the data received from the sensors, the particular heater will get enabled.

2. MRR temperature sensor:

A micro-ring resonator (MRR) generally consists of a silicon-based linear waveguide coupled to a ring structure. The structure has two ports one is the in-port, and the other is the through-port. A basic structure has been shown in fig. 1.

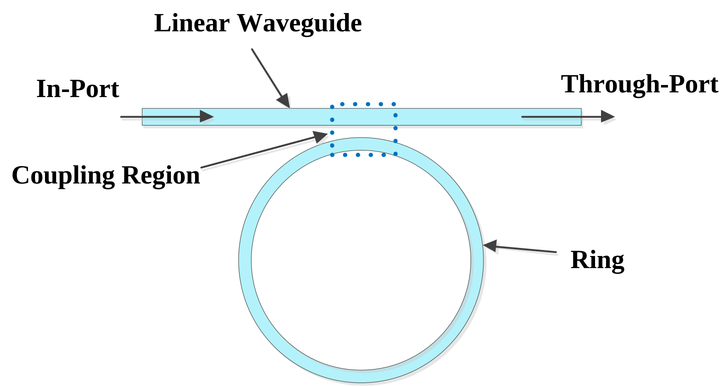

Fig 1: A ring resonator structure

In such structures, light of a particular wavelength is sent via the linear waveguide's in-port, where the incident light, while traveling, interferes first with the ring structure. A small portion of the light thus gets evanescently coupled to the ring from the linear waveguide. This light interferes again with the light coming through the linear waveguide after every trip around the ring. Resonance will occur if the optical path length of the ring is an integer multiple of the wavelength of the laser light used.

An MRR can be used as a precise temperature sensor. It works on the principle of thermal expansion of silicon micro-ring that causes a change in the refractive index. This change in the refractive index of the silicon ring structure ultimately results in shifting the resonance wavelength due to a change in the ring dimension. The overall change in the ring characteristics is because of two factors mainly, i.e., the thermo-optic effect (TO) and the thermal expansion effect (CTE). The CTE and TO coefficients for silicon are approximately 2.5*10-6 /°C and 1.86*10-4 /°C, while the refractive index for silicon is 3.48.

The refractive index is changed by the thermo-optic effect, whereas the ring's circumference is altered by the thermal expansion effect, which is almost negligible [6, 7]. We can determine the resonant wavelength of the ring resonator by,

$$\lambda_{res} = \left[n_{eff}(\lambda_{res}, T).\,L(T)\right]/m \tag{1}$$

We can write the overall shift in the resonance wavelength by,

$$\Delta\lambda = \Delta\lambda_{CTE} + \Delta\lambda \tag{2}$$

$$\frac{\frac{\partial n_{eff}}{\partial T} + n_{eff}\left(\frac{\partial L}{\partial T}\right)\left(\frac{1}{L}\right)}{n_g}$$

Where,

n_{eff} = the effective refractive index,

L = the total circumference of the ring waveguide, n_g = the group index.

3. Methodology

In this section, we have demonstrated a temperature monitoring system using optical sensors implemented inside a farm. The system is connected to the end-user device via an IoT network. Fig. 2 depicts the diagram of the proposed temperature monitoring system.

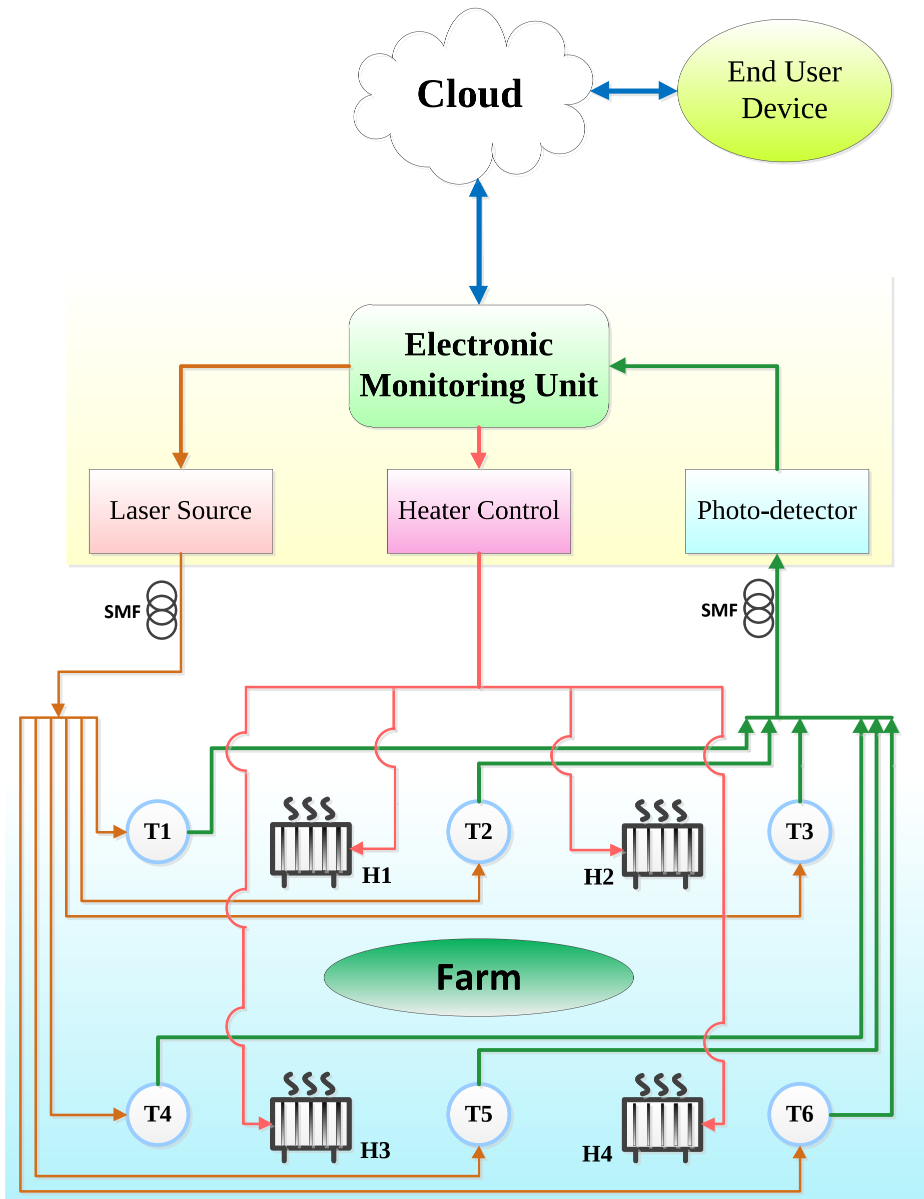

Fig. 2: The proposed IoT based farm temperature monitoring

The system consists of six MRR-based optical sensors (T1, T2,…T6) placed at six locations inside the farm. Each of these sensors is connected to a fiber that runs from the control unit to the farm. A laser has been installed at the control unit where the fiber is connected, transmitting the light to the sensor units. The sensor unit will have a ring with a linear waveguide in which the laser light will enter via the in-port terminal. Due to variations in temperature, the shift in the resonance in the ring structure causes a variation in the intensity of the output light from the through-port of the MRR structure as shown in fig. 3.

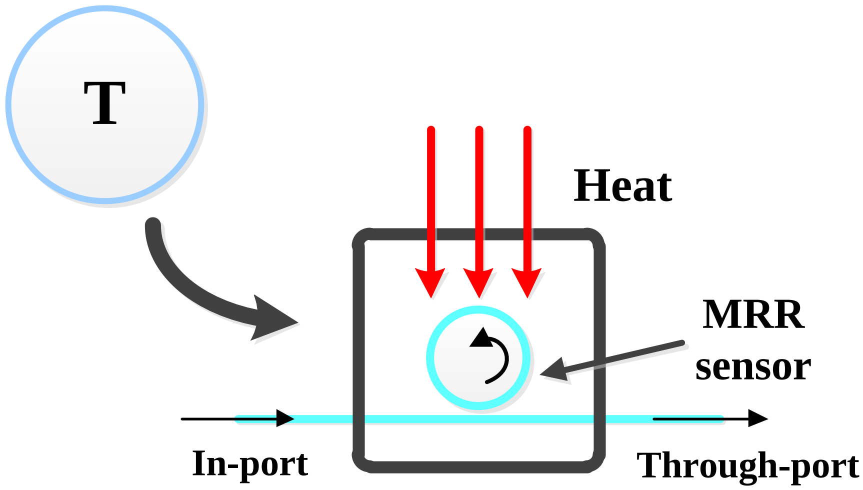

Fig. 3: Internal structure of MRR sensor

The output from each of the sensors is then fed back to the electronic control unit via a fiber where the photodetectors are installed. The electronic circuitry monitors the change in the temperature with respect to the light output and controls the heater units at particular locations inside the farm. The real-time data is processed, stored, and sent to the remote end user via a cloud network.

4. Conclusion:

In this paper, we have presented an optical temperature sensor that has been used inside a farm. Temperature is a vital parameter for livestock, mainly for poultry and dairy farming. The proposed IoT-based temperature monitoring system uses six MRR-based optical sensors to precisely sense the change in the temperature and control the heater units, thereby sending real-time monitoring data to the remote end users via the Internet of things.

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Suman Debnath is currently pursuing his PhD in the Dept. of Electronics and Communication Engineering at Tripura University, India. He received his B.E degree from Maharashtra Academy of Engineering, Pune 2012, and M.Tech degree in Electronics and Communication Engineering from Tripura University in 2020. His research interests include photonic integrated circuits, machine learning, optical communication, and optical networks. He is currently working on optical modulator design, optical gate and machine learning.

Srikanta Das is currently pursuing his PhD at Tripura University, India. He received his B.E degree from Tripura Institute of Technology, Tripura in 2016, and M.Tech degree in Electronics and Communication Engineering from Tripura University in 2018. His research interests include silicon photonics, photonic integrated circuits, fiber optics communication, and optical networks. He is currently working on optical gate and optical sensor design in silicon

Satyabrata Singha is currently pursuing his PhD at Tripura University, India. He received his B.Tech degree from North-Eastern Hill University, Meghalaya in 2015, and M.Tech degree in Electronics and Communication Engineering from Tripura University in 2018. His research interests include silicon photonics, photonic integrated circuits, fiber optics communication, and optical networks. He is currently working on optical modulator design in silicon photonics platform.

Nitish Sinha is currently pursuing his PhD in the Dept. of Electronics and Tele-communication Engineering Tripura University. He received his BE degree from Tripura Institute of Technology, India in 2018, and his MTech degree in Electronics and Communication Engineering from Tripura University, India in 2020. He is the author of more than five journals and conferences. His current research interests include optical Communication, Machine Learning, and opto-electronic systems. He is a member of IAENG.

Bishanka Brata Bhowmik is an Assistant Professor at Tripura University in the Department of Electronics and Communication Engineering. He received his PhD from the Indian Institute of Technology Patna, India. His research interests include optical fiber communication, coherent optical communication, optical signal processing, long haul optical communication, all-optical signal processing, optical network, and photonics.

Senthilkumar Piramanayagam has over 14 Years of experience in the Automotive industry. He has exposure to all phases of the SW and System development life cycle. He has experience in project management experience with different teams. He has experience in SIL validation, Coding & Verification, and the Quality & Safety team. He has exposure to working & handling Tier 1 suppliers and OEMs in different geographic locations. He is a Certified ISO26262 Functional Safety Level 1 & ASPICE 3.0 Provisional Assessor.

Prasad Mahudapathi is a Goal-Oriented and Collaborative Consultant with over 13 years of enterprise-level technical experience as a Solution Implementation, VMware Consultant, Solution Design, Consulting, Automation, IT Transformation and Operations, Server Consolidation, Business Continuity, and Disaster Recovery in alignment with ITIL processes establishing Change, Incident, and Problem Management.

HEAD ARMOR FOR SMART WORKER USING INTERNET OF THINGS

[1]S.K. Manju bargavi, [2]Nivetha, [3]Lokesh, [4]K. Bala Nithiya
[1]School of CS & IT, Jain Deemed-to-be University, Bangalore
[2,3]MCA,School of CS & IT,Jain Deemed-to-be University, Bangalore
[4]Nextgear Capital Carmel Indiana, USA
[1]cloudbargavi@gmail.com

Abstract:
The number of Mine & Construction workers passing away at the site is rising daily. However, there are still no opportunities to lower this fatality rate. Therefore, this system suggests a smart flexible helmet for the workers to provide security and rescue measures in case of any panic circumstances. This helmet is intended to provide constant observation of the labours and to prevent them from any health threats while working. The project's goal is to make construction sites safer and more secure for workers, hence lowering the number of fatalities. To safeguard the Worker, the helmet has a variety of sensors. The internet of things-based smart helmet is put together by combining all the components into a single helmet. A clever, reasonably priced helmet for the employees is described in the suggested system.
Keywords: Accident, Helmet, IoT, Sensors, Workers.

1. Introduction:
This project's primary goal is to lower the probability of accidents occurring at industrial or construction sites. People who work in mining or construction sites must contend with a variety of environmental factors. Due to the improper balance between work and their safety, the employees deal with several issues and challenges in the job. They are not only physically harmed, but also emotionally[3-5]. The building sector is the one that causes the most fatalities among all other industries. Gases like methane, carbon monoxide, and temperature pose a threat to them[1,2]. Therefore, we must give those folks strong security. One of the riskiest professions in the world is mining. We created a Smart Working Helmet with Arduino that, in the event of a mishap, might save their lives.

2. Prevention For Worker Head Armor:
- Although many people choose not to wear safety helmets while working, their importance should not be understated. Without a safety helmet, the protective clothing is insufficient.
- Really do not forget to wear a safety helmet if you are working on a construction site or any other location where heavy equipment and machinery are in use.
- The helmet wants to be in proper fit with strap adjustment
- Worker wants to clean the helmet for avoiding dust.
- Protection against slips, tips and falls[8].
- Provides sun protection.
- Safety helmets are made to completely protect employees from head impacts, electric injuries, and penetration injuries that can be brought on by heavy item falls. As a helmet, it can offer protection to workers head.
- Helmet wearing monitoring feature which tells whether the worker wore the helmet or not[6,7].
- Body Temperature detection it notifies when the body temperature exceeds a normal body temperature.

3. System Architecture:

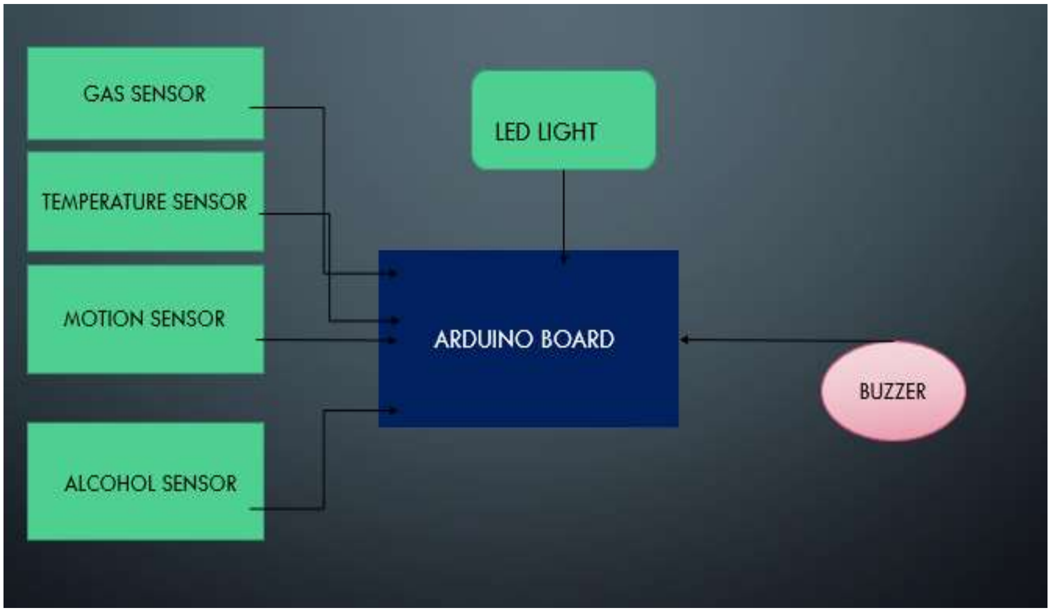

Fig.1-Architecture

Here we had used :

1. Gas Sensor
2. Temperature Sensor
3. Motion Sensor
4. Alcohol Sensor
5. LED light
6. Buzzer
7. Arduino Board

3.1 Temperature Sensor:
Using this sensor, we can alert a worker when the working environment or the body temperature(heat) arises.

3.2 Gas Sensor:
It helps in this project is that, when an exploitation occurs in mining there suddenly it leads to the leakage of poisonous gases and it causes breathing problems and sometimes even death.

3.3 Motion Sensor:
This sensor is used to detect the movement of a worker. Whether he is working or not. Mainly used to detect the status of the worker.

3.4 Alcohol Sensor:
In case if some of the worker had drink alcohol during working or already he done whatever it is the sensor will alert by buzzer sound.

3.5 LED light:

Suppose if a worker is not in a working state it will be indicated with red light and if he/she is in movement it will be indicated with green light.

3.6 Buzzer:

Buzzer is used to alert worker if anything goes wrong. It makes sound to alert the worker.

3.7 Arduino Board:

Above all sensor, buzzer, led light had connected to the Arduino Board. The System Architecture Fig.1 is clearly showing the connection of the project.

4. Conclusion

This suggested solution uses a microcontroller-based circuit on the worker helmet to track workers via the Internet of Things and to provide a safety system for the mining and construction sectors. The most efficient, useful, environmentally friendly, and safest method for protecting those working in the mining and construction industries is this system. Additionally, this method allows for constant access to subsurface data. The issues that the world is currently confronting are unmistakably addressed in the coalfield. This will assist all of the miners within the mine save their lives before any casualties happen. An effective platform for enhancing job quality and safety is produced through real-time monitoring and a quick alarm system.

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Dr. Manju bargavi S.K. is a Professor in the Department of Computer Science and IT in Jain (Deemed-to-be University), Bangalore, India. She has obtained PG and doctoral degrees from Anna University, Tamil nadu, India. She has 18+ years teaching experience in various engineering colleges located in India and Abroad. Her area of specialization is wireless ad hoc network, IoT, Security and image processing. She has published several books, patent and research papers in international journals related to computer science & engineering

Balanithiya .K. is a Sr. Software Test Engineer(Automated) in Nextgear Capital, USA. She has good experience in Automation Testing and Manual testing - Functionality, Integration, GUI, Regression, Configuration, Load, and Smoke Testing of Web, PC, Mobile and Client-Server based applications on various platforms. Moreover, experience in writing Test Plans, Test Cases, Test Scripts, Bug Reports, and Test Documents. Experience in reviewing Business Requirement documents, Change Requests, Developer/QA code.

Advancement of Federated POI Recommendation Using IoT Location Information

[1]Shreya Roy, [2]Abhishek Majumder

[1,2]Mobile Computing Lab,Department of Computer Science and Engineering,
Tripura University,Tripura, India.

e-mail id: [1]royshreya654@gmail.com, [2]abhi2012@gmail.com

Abstract: With the popularization of clever gadgets and the fast improve- ment of the Internet of Things (IoT) along with location-based social networks (LBSN), the point of interest (POI) recommendations have also been largely researched to create successful application in the industry. Human mobility and emotions are becoming an essential topic in the field of recommendation systems. Generation of such information is done via numerous location-sensing information collected from mobile devices. Various models have been developed to find the most efficient recommendations of POIs for the users. Different models sometimes integrate a number of factors that influence POI recommendations such as user interests, location popularity, visit times, etc. On the other hand, privacy concerns are also brought into this arena, as the recommendation model requires private data to be uploaded to a central server. This report reviews recent research works on user privacy preservation in IoT environments for POI recommendation systems and the literature on their relative performances. This review also includes various limitations of those discussed research works, which can be considered as the basis for future scope in the POI recommendation systems.

Keywords: Point-of-Interest, Location-Based Social Network, Recommendation System,Interest, Popularity, Internet of Things.

1 Introduction

Locations are very extensive factor in case tour and travel planning, also it is necessary to select proper locations and schedule them accordingly.With fast generality of mobile devices embedded with wireless communication and loca- tion sensors the recommendation system finds the best possible locations and refers them to the user, based on different choices and interests of users over cities. Point of Interest (POI) basically provides personalized recommendations to the user based on any user-defined data or any open data. It is pretty much well- known that human behavior is consistent, which makes learning and predicting the patterns of human behaviors much easier (Funder & Colvin,1991) ,(Khan et al.,2013).

With the rapid blooming of smart mobile devices as well as web connection nowadays LBSNs helps the user to share their locations. There are a few LBSNs available namely, Foursquare (Li et al.,2017) , Yelp, Facebook, Geolife, and Gowalla (Long & Joshi,2013), etc. These LBSNs help users to establish connections, upload photos, location sharing by means of check-in data (Luan et al.,2017). The LBSNs basically need to have rich information from wireless devices and need to be very much prompt about user preferences so that they can recommend new places to users that the user may be interested to visit. The traditional POI recommendation system architecture considers the user's check-in-related information from several mobile devices and utilizes them in any compatible recommendation framework to present the list of POIs to the user. Building robust recommendation models to attain high suggestion quality is a primary focus of earlier efforts on POI recommendation (Feng et al.,2020), (Hosseini et al.,2016). POI models incorporate a number of POI- related parameters, including geographical category, distance, time, and social relationships. But in addition to model development, the entire recommendation process also involves data gathering and recommendation presentation. Most studies merely adopt a centralized learning paradigm without considering the significance of those two stages. An edge-accelerated federated learning based on centralized learning has been introduced for POI recommendation as it emphasizes the protection of the data owner in the IoT environment during the model training process (Aledhari et al.,2020),(Zhang et al.,2021),(Yu et al.,2022).

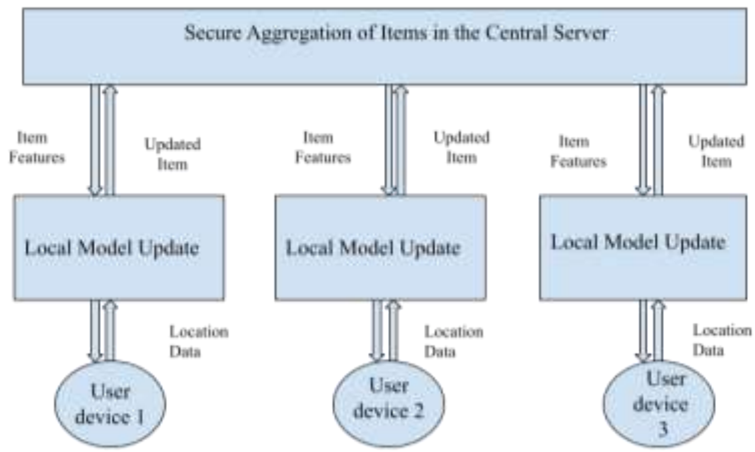

Figure 1: Federated Learning Architecture

Federated Learning(FL) has surfaced as a distributed learning which has the ability to perform numerous intelligent IoT operations. Federated learning is a developing field in the machine learning industry, and it has already proven to be significantly more advantageous than centralized, traditional methods (Aledhari et al.,2020). The advantages of federated education includes Data protection: keeps the training data on the devices, negating the need for a data pool for the model. Businesses are prevented from combining data-sets from many sources. There are issues other than data security, such as network unavailability in edge devices. Data diversity: Federated learning makes it easier to access diverse data, even when particular data sources can only interact at specific periods. Real-time continuous learning: Without the need to aggregate data, models are continuously upgrading using client data. Hardware effectiveness: Federated learning models do not require a single complex central server to evaluate data, this method employs less complex hardware. Federated learning models can be used with a variety of machine learning approaches, but it's crucial to consider the data type and context. Applications could include tracking mobile phone users, developing driver-less cars, and anticipating health concerns from wearable technology. In this paper, the goal is to identify and analyze the techniques of federated learning used in POI recommendations and to summarize the most important topics that should be considered for future research. The literature survey has been done in terms of information resources, and methodologies to analyze more details of those works.

2 Literature Survey

2.1 Privacy Preserving POI Recommendation System

The privacy issues of recommendation models come into the view of community and public recently. The smart devices collects and uploads private data to the centralized server.It has been done without enough regulation lately which makes the privacy of users a critical issue . Feng et al.(2020) proposed Privacy-preserving Mobility prediction Framework (PMF) using federated learning.The aim is to provide accurate prediction in mobility. The framework helps in protecting personal privacy without neglecting the prediction performance. In the framework, private data is not uploaded into the centralized server because of the deep learning mobility model. A fine-tuned personal adaptor introduced (Feng et al.,2020) for personal modelling which enhances the performance of prediction. Limitations:The model can have noisy data and lots of missing data in multi-modal learning.Advance model can be incorporate to achieve the global optimization.

Most existing approaches establishes centralized models considering users' private data. As per Chen et al. (2020) both private data and models are controlled by the recommender as a result serious privacy concerns may generate. Hence, they proposed a novel Privacy preserving POI Recommendation (PriRec) framework (Chen et al.,2020). The framework also enjoys promising scalability. PriRec follows Factorization Machine (FM) with a linear model and the feature interaction model. The framework generates dynamic POI features using Local Differential Privacy (LDP). Limitations:Although the model has huge scalability and cost efficiency there is
a high risk of data modification and corruption.

Huang et al.(2022) proposed a Federated Learning (FL) approach for geographic POI recommendations. The POI recommendation is formulated with a matrix factorization optimization problem using singular value decomposition (SVD) technique. To designing FL framework stochastic gradient (Huang et al.,2022). The goal of this recommendation model is to minimize the sum of squared errors (SSE) between predictions and the ground truth. Limitations:The model does not provide any clear evidence that their geographic location information is not threatened by complete potential space.

To improve privacy Gou et al. (2021) proposed an edge-accelerated federated learning framework for POI recommendation (PREFER). The framework shares multi-dimensional user-independent parameters from local recommendation model instead of check-in data. Efficiency of the recommendation has been improved by aggregating these distributed parameters (Gou et al.,2021) on edge servers in- stead of remote cloud servers. Limitations:The uppermost challenge in the model aggregation stage is the heavy communication burden. The edge server covers limited users, the recommendation quality decreases to some extent compared to the global aggregation.

Usually users are not be willing to share their sensitive information with a central server. Hence, data ownership has become a crucial concern. Considering the fact Anelli et al.(2021) produced an architecture, which allows user collaboration in a central factorization mode to control the amount of sensitive data leaving the respective devices. In order to accomplish the secure POI recommendation, the model implements pair-wise learning-to-rank optimization (Anelli et al.,2021) followed by Federated Learning. Limitations:This model accepts a very less amount of information from the server, hence, it could share no positive feedback with the server which is can be a limitation of the model. Sharing zero amount of positive data can lead to wrong suggestions to the user while recommending POI.

Gurukar et al.(2021) presented a simple yet novel model called LocationTrails for learning efficient location embedding. LocationTrails recommends without requiring the complete data to be uploaded on a central server (Gurukar et al.,2021). The model reflects human mobility patterns by learning a vector representation of locations. The efficacy of the model has been established in terms of better generation of embedding quality, memory consumption, and execution time. Limitations:The model used federated learning in distributed fashion for mitigating some risks to privacy where the device builds its own model using its local data by sharing a tiny amount of information but if global data training had been incorporated then the model efficiency could be improved by a big factor to protect data-breach.

Due to the widespread usage of LBSNs, predicting locations has received huge attention. Considering the spatio-temporal information of LBSNs Wang et al. (2022) proposed a novel spatiotemporal location prediction framework (STLPF) that integrates data from local and global views of each client.As per the author people visit is only a small portion area that of the map.Hence,the information are sparse. To reduce it, the longitude and latitude are encoded using the quad key encoder. In case of the absence of a global model, clients can collectively train their respective personalized models using a new personalized federated learning architecture (Wang et al.,2022). Limitations: The one issue is that, the quad key is embedded directly here. In the case of closer locations model may lead to similar quad keys and it has been observed that direct embedding cannot capture the similarity between locations. Hence, a self-attention network is additionally required which makes the system computationally complicated.
A brief overview of few of the above-mentioned algorithms with highlighted comparison factors is given in Table 1.

Table 1: Comparison of POI Recommendation Models Using Federated Learn- ing.

Algorithm	PMF	PriRec	PREFER	STLPF
Methodology	Long Short-Term Memory	Local Differential Privacy	Matrix Factorization	Self-attention Mechanism
Federated Learning Algorithm	FedAvg	Gradient Aggregation Strategy	Federated Learning paradigm	Adaptive Personalized Federated
Optimization	Stochastic Gradient Decent	Click Through Rate prediction problem	Gradient updation	RmsProp
Dataset	Foursquare,Twitter,DenseGPS	Foursquare,Koubei	Foursquare,Gowalla	Foursquare

No. of Users	2293; 24161; 5000	11,824 ; 85,466	3817 ; 3386	3379
No. of Locations	67,124; 52,7977; 31,522	13,924; 118,598	7754; 6957	90546

The mentioned Figure 2 shows the performance accuracy that has been increasing from time to time. This clearly indicates that privacy protection is an important concern and is expected to evolve in the recommendation system in the IoT environments. Various models have incorporated Federated learning as a spare part of POI recommendation system. The goal is just to make users assured that their personalized location data are being accessed securely.

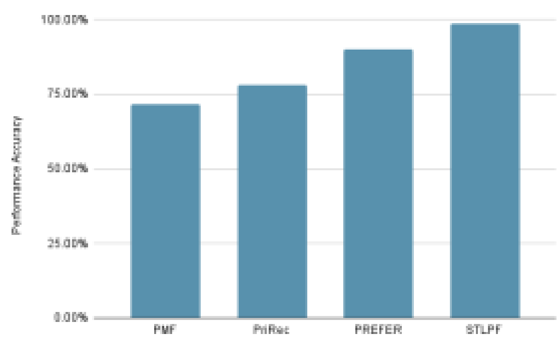

Figure 2: Performance Accuracy Analysis of Federated Learning Based Models .

3 Conclusion and Future Work

The conclusion along with the promising future direction of the research has been mentioned here. It had been observed that heterogeneous features improve predictions when recommending POIs. Based on the above context, many techniques have been proposed by researchers. Apart from that, an additional required feature called Federated Learning was introduced. This is intended to protect the privacy of user information gathered from different smart devices as we are concerned about uploading personal information over the internet. There are difficult problems and limitations present in this particular area. Hence, new methodologies need to be developed. Such methodologies can be viewed as an improved or extended version of existing research for mitigating these challenges and providing a broader range of recommended processes considering aspects of better quality and accuracy. In the future, it would be desirable to delve deeper into federated learning approaches to capture the area of a smart location recommendation system.

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Miss Shreya Roy currently is a research scholar of Department of Computer Science and Engineering Department at Tripura University, India.Her main research interest includes artificial intelligence, machine learning, and recommendation system.She posses one and half years of industrial experience in the field of programming and development.She had completed her B.Tech,M.Tech in Computer Science and Engineering from ICFAI University Tripura and Tripura University respectively.

Dr. Abhishek Majumder is an academician and researcher with more than 10 years of experince.Currently he is the faculty and Head of Department of Computer Science and Engineering Department at Tripura University, India. His main research interests include algorithms, cryptography, IoT Security and data privacy.He is currently working as Assistant Professor in the Department of Computer Science and Engineering, Tripura University (A Central University). Prior to joining Tripura University he had worked as Assistant Professor in the Department of Information Technology (Currently Department of Computer Science and Engineering, Assam University (A Central University).He had completed his BE, M.Tech and PhD from NIT Agartala, Tezpur University and Assam University respectively. He has published more than 50 papers in National and International Journals and Conferences.He has also authored many book chapters in books published by reputed publishers. As Principal Investigator/Coordinator he has handled projects funded by Ministry of Electronics and Information Technology, Government of India and AICTE.

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