The book series *Lecture Notes in Electrical Engineering* (LNEE) publishes the latest developments in Electrical Engineering - quickly, informally and in high quality. While original research reported in proceedings and monographs has traditionally formed the core of LNEE, we also encourage authors to submit books devoted to supporting student education and professional training in the various fields and applications areas of electrical engineering. The series cover classical and emerging topics concerning:

- Communication Engineering, Information Theory and Networks
- Electronics Engineering and Microelectronics
- Signal, Image and Speech Processing
- Wireless and Mobile Communication
- Circuits and Systems
- Energy Systems, Power Electronics and Electrical Machines
- Electro-optical Engineering
- Instrumentation Engineering
- Avionics Engineering
- Control Systems
- Internet-of-Things and Cybersecurity
- Biomedical Devices, MEMS and NEMS

For general information about this book series, comments or suggestions, please contact leontina.dicecco@springer.com.

To submit a proposal or request further information, please contact the Publishing Editor in your country:

**China**

Jasmine Dou, Editor (jasmine.dou@springer.com)

**India, Japan, Rest of Asia**

Swati Meherishi, Editorial Director (Swati.Meherishi@springer.com)

**Southeast Asia, Australia, New Zealand**

Ramesh Nath Premnath, Editor (ramesh.premnath@springernature.com)

**USA, Canada:**

Michael Luby, Senior Editor (michael.luby@springer.com)

**All other Countries:**

Leontina Di Cecco, Senior Editor (leontina.dicecco@springer.com)

**This series is indexed by EI Compendex and Scopus databases.**

More information about this series at http://www.springer.com/series/7818
Preface

This book is a compilation of selected high-quality peer-reviewed papers from the International Conference on Communication, Circuits and Systems (ic3's2020) held during October 16–18, 2020, at the Kalinga Institute of Industrial Technology, Deemed to be University, Bhubaneswar, India. The book presents the latest development in the field of intelligent computing, advances in communication, signal processing, control systems, VLSI and embedded systems, artificial intelligence, and IoT. The book offers a timely and thorough survey of the latest research in the field of electronics and computing. It consists of papers that share the latest breakthroughs in and promising solutions to the most important issues facing today’s society. Written by scientists, academicians, and research scholars from leading institutions and universities, it will be beneficial for readers from both academia and industry.

Bhubaneswar, India
Bhubaneswar, India
Bhubaneswar, India
Singapore

Sukanta Kumar Sabut
Arun Kumar Ray
Bibudhendu Pati
U Rajendra Acharya
Contents

Academic Students Attendance System: A Case Study of Alexa Skill Development ................................................. 1

Implementation of Low-Cost and Low-Power-Based Temperature and Air Quality Monitoring System for a Local Area in Odisha ........ 7
Rudra Swarup Sahoo, Umakanta Samantasinghar, Adyasa Priyadarsini Acharya, and Priyabrata Biswal

Comparison Between LSTM and RNN Algorithm for Speech-to-Speech Translator ......................................................... 15
Bageshree Pathak, Shipra Mittal, Komal Shinde, and Pranjali Pawar

Interactive and Non-Interactive Control-Based Lossless Grounded Negative Inductance Simulator Using Current Differencing Buffered Amplifier ......................................................... 23
Shekhar Suman Borah and Mourina Ghosh

Exploring Novel Techniques to Detect Aberration from Metal Surfaces in Automobile Industries ............................. 31
Debaniranjan Mohapatra, Amit Chakraborty, and Ankit Kumar Shaw

Detecting Diseased Leaves Using Deep Learning ....................... 41
Sourodip Ghosh, Anwita Chakraborty, Ahana Bandyopadhyay, Ishita Kundu, and Sukanta Sabut

Energy Storage System Analysis and Optimization for Photovoltaic-Based Pico Hydro System in Remote Village ................................................................. 47
Tapas Chhual Singh, G. R. K. D. Satyaprasad, Kali Charan Rath, and P. Srinath Rajesh

Coplanar Wave Guide Fed Dual Band Antenna Loaded with Metamaterial Split Ring Resonator ............................. 53
Mekala Harinath Reddy, D. Sheela, J. Premalatha, and Abhay Sharma
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design of Low Power Multipliers Using Approximate Compressors</td>
<td>65</td>
</tr>
<tr>
<td>Vishal Gundavarapu, M. Balaji, and P. Sasipriya</td>
<td></td>
</tr>
<tr>
<td>Block-Based Local Binary Pattern for Recognition of Handwritten</td>
<td>73</td>
</tr>
<tr>
<td>Odia Numerals</td>
<td></td>
</tr>
<tr>
<td>Suchismita Behera and Niva Das</td>
<td></td>
</tr>
<tr>
<td>Performance Evaluation of Different Machine Learning Techniques for</td>
<td>81</td>
</tr>
<tr>
<td>Detection of Non-technical Loss</td>
<td></td>
</tr>
<tr>
<td>Adyasha Banajyoti and C. N. Bhende</td>
<td></td>
</tr>
<tr>
<td>An Overview with Current Advances in Industrial Internet of Things</td>
<td>89</td>
</tr>
<tr>
<td>(IIoT)</td>
<td></td>
</tr>
<tr>
<td>T. Primya, G. Kanagaraj, and G. Subashini</td>
<td></td>
</tr>
<tr>
<td>Video Indexing Through Human Face</td>
<td>99</td>
</tr>
<tr>
<td>Sanjoy Ghatak and Debotosh Bhattacharjee</td>
<td></td>
</tr>
<tr>
<td>Acquisition and Analysis of Skin Impedance in Parkinson’s Disease</td>
<td>109</td>
</tr>
<tr>
<td>Revati Shriram, Akshata Shinde, Radhika Nibhande, Anchal Guleria,</td>
<td></td>
</tr>
<tr>
<td>and Rashmi Atre</td>
<td></td>
</tr>
<tr>
<td>Automation of Soil Nutrient Measurement System and Irrigation Control</td>
<td>117</td>
</tr>
<tr>
<td>U. B. Mahadevaswamy, R. Pavan Nayak, M. N. Darshan, Tallam Vineeth</td>
<td></td>
</tr>
<tr>
<td>Kumar, and S. Gautham Gopi</td>
<td></td>
</tr>
<tr>
<td>Performance Evaluation of Perovskite Solar Cells at Elevated</td>
<td>127</td>
</tr>
<tr>
<td>Temperatures</td>
<td></td>
</tr>
<tr>
<td>Sumanshu Agarwal, Archana Kumari Munda, Vedika Pandey, and Kundan</td>
<td></td>
</tr>
<tr>
<td>Kumar</td>
<td></td>
</tr>
<tr>
<td>Implementation of Transfer Learning Technique for the Detection of</td>
<td>135</td>
</tr>
<tr>
<td>COVID-19</td>
<td></td>
</tr>
<tr>
<td>Amit Prakash Sen and Nirmal Kumar Rout</td>
<td></td>
</tr>
<tr>
<td>Blockchain Enabled and Changeable Threshold-Based Group Specific</td>
<td>141</td>
</tr>
<tr>
<td>Multiple Keys’ Negotiation</td>
<td></td>
</tr>
<tr>
<td>Anindya Kumar Biswas and Mou Dasgupta</td>
<td></td>
</tr>
<tr>
<td>Speech to Sign Language Conversion Using Neuro Fuzzy Classifier</td>
<td>149</td>
</tr>
<tr>
<td>Pooja Narshetty and H. Y. Vani</td>
<td></td>
</tr>
<tr>
<td>Design and Development of an Ultra-wideband Millimetre-Wave Antenna</td>
<td>157</td>
</tr>
<tr>
<td>for Short-Range High-Speed Communication</td>
<td></td>
</tr>
<tr>
<td>Debraj Dhang, Satyadeep Das, and Sudhakar Sahu</td>
<td></td>
</tr>
<tr>
<td>A Comparative Analysis of BTC Variants</td>
<td>163</td>
</tr>
<tr>
<td>D. Nayak, K. B. Ray, and T. Kar</td>
<td></td>
</tr>
</tbody>
</table>
Crosstalk Noise Reduction in Long Wire Interconnects Using MTCMOS Inverters ............................................... 171
Jayashree Mallidu and Saroja V. Siddamal

GPS and GSM Enabled Smart Blind Stick ........................... 179
Sourodip Ghosh, Moinak Bose, and Ankit Kudeshia

Prediction of Speed for Smart Insulin Pump Utilizing Adaptive Neuro-fuzzy Inference System and ANN ................. 187
J. V. Alamelu and A. Mythili

Curvelet Transform and ISODATA Thresholding for Retinal Vessel Extraction .................................................. 195
Sakambhari Mahapatra, U. R. Jena, and Sonali Dash

Design a T-Shape Cantilever Beam Using by Scilab and COMSOL .... 205
Vasagiri Suresh, Burra Rajesh Kumar, and Vankara Jyothi

Design and Analysis of PZT-Based Piezoelectric Speakers ............. 215
Vasudha Hegde, Christina David, E. Shirley Jesseca, Shreya Nadgouda, and S. M. Vrinda

Drowsiness and Yawn Detection System Using Python ................ 225
Surabhi Kumari, Kumari Akanksha, Sasmita Pahadsingh, Swati, and Supriya Singh

Intelligent Analysis of X-Ray Images for Detecting Bone Abnormality in Upper Extremities .................................. 233
Puja Kalivarapu, Rufina Flora George Rajan, and B. Niranjana Krupa

Swarm Optimization of Multiple UAV’s for Resource Allocation in Humanitarian Aid and Disaster Relief Operations ............. 241
Anant Shukla, Rishav Choudhary, and Malavika Prabhuram

Hardware Design of a Turbo Product Code Decoder ................. 249
Gana C. Nair, B. Yamuna, Karthi Balasubramanian, and Deepak Mishra

Multiple Object Detection and Tracking Using Deep Learning ........ 257
Shreyas Burde and Suneeta V. Budihal

Blood Donation Management System Using Android Application ...... 265
Ahana Bandyopadhyay, Ishita Kundu, Anwita Chakraborty, Rajat Kumar, Ayush Kumar, and Sukanta Sabut

Reinforcement Learning for Improving Coherence of Multi-turn Responses in Deep Learning-Based Chatbots ................. 273
D. G. Suhaas Kiran, Swapneel, Safal Deepak Pansare, and B. N. Krupa
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensification of Bandwidth, Return Loss and Gain of Ultra-Wideband Microstrip Antenna with Single-Band-Notch (U-Slot) Characteristics</td>
<td>281</td>
</tr>
<tr>
<td>Manisha Mohanty and Bikram Choudhury</td>
<td></td>
</tr>
<tr>
<td>Design of Multi-utility Bottleneck Horn Antenna for Ku-, K-, and Ka-Band Applications</td>
<td>289</td>
</tr>
<tr>
<td>Yagnik Mehta, Nisarg Patel, Ronak Vashi, and Jagdish Rathod</td>
<td></td>
</tr>
<tr>
<td>Cyberbully Detection Using 1D-CNN and LSTM</td>
<td>295</td>
</tr>
<tr>
<td>Sourodip Ghosh, Aunkit Chaki, and Ankit Kudeshia</td>
<td></td>
</tr>
<tr>
<td>Comparative Study of Skin Lesion Segmentation and Feature Extraction in Different Color Spaces</td>
<td>303</td>
</tr>
<tr>
<td>A. Veeramuthu, A. Anne Frank Joe, B. S. Sathish, L. M. I. Leo Joseph, P. Ganesan, and V. Elamaran</td>
<td></td>
</tr>
<tr>
<td>Recognition of Handwritten Digit in Free Space</td>
<td>313</td>
</tr>
<tr>
<td>Manas Chandan Behera, B. Shivalal Patro, and Ritik Gupta</td>
<td></td>
</tr>
<tr>
<td>An Area-Efficient 1.23 V Current-Mode Bandgap Reference with Start-Up Circuit</td>
<td>321</td>
</tr>
<tr>
<td>Aditya Kumar Hota and Kabiraj Sethi</td>
<td></td>
</tr>
<tr>
<td>Design of AlGaAs/InGaAs/GaAs-Based PHEMT for High Frequency Application</td>
<td>329</td>
</tr>
<tr>
<td>Geeta Pattnaik and Meryleen Mohapatra</td>
<td></td>
</tr>
<tr>
<td>Signal Propagation Modelling on the Inner Surface of Human Arm</td>
<td>339</td>
</tr>
<tr>
<td>Deepak Kumar Rout, Asha Rani Mohapatra, Rishu Bhardwaj, Raunak Kumar, and Vedant Raj Singh</td>
<td></td>
</tr>
<tr>
<td>Detection of Brain Tumor from MR Images Using BWT and SOM-SVM with Authentication</td>
<td>347</td>
</tr>
<tr>
<td>Nilesh Bhaskarrao Bahadure, Sidheswar Routray, and Arun Kumar Ray</td>
<td></td>
</tr>
<tr>
<td>Wavelet Transform for Signal Compression in Sparse Algorithms</td>
<td>355</td>
</tr>
<tr>
<td>Rosalin, Nirmal Kumar Rout, and Debi Prasad Das</td>
<td></td>
</tr>
<tr>
<td>Performance Evaluation Based on Classification of Web Log Data: A Machine Learning Approach</td>
<td>363</td>
</tr>
<tr>
<td>Varun Malik, Ruchi Mittal, Jaiteg Singh, and Pawan Kumar Chand</td>
<td></td>
</tr>
<tr>
<td>Energy and Direction Aware Routing Protocol for Flying Ad Hoc Networks</td>
<td>371</td>
</tr>
<tr>
<td>Sudesh Kumar, Ram Shringar Raw, and Abhishek Bansal</td>
<td></td>
</tr>
<tr>
<td>Performance Comparison of Tree-Based Machine Learning Classifiers for Web Usage Mining</td>
<td>379</td>
</tr>
<tr>
<td>Ruchi Mittal, Varun Malik, Vikas Rattan, and Deepika Jhamb</td>
<td></td>
</tr>
</tbody>
</table>
Design of Current Mode MOS Logic for Low-Power Digital Applications ...................................................... 493
Amit Bakshi, S. N. Mishra, and Sandeep Kumar Dash

Augmented Reality as a Supported Educational Method for Embedded Devices and Technology ...................... 501
Sambit Prasad Kar, Maitrish Ghosh, and Nirmal Kumar Rout

Reweighted Zero-Attracting Modified Variable Step-Size Continuous Mixed $p$-Norm Algorithm for Identification of Sparse System Against Impulsive Noise .................................... 509
Ansuman Patnaik and Sarita Nanda

A Semantic-Based Information Retrieval System ..................... 517
Alka Ranjan and Soumya Priyadarsini Panda

Multiband Ultrathin Terahertz Metamaterial Absorber for Sensing Application ................................................ 525
Shruti and Sasmita Pahadsingh

Frequency Estimation Using Adaptive Algorithm ...................... 533
Sananda Kumar

An Improved Ridge Regression-Based Extreme Learning Machine for the Prediction of Diabetes ...................... 541
Priya Das and Sarita Nanda

MIMO-OFDM Outdoor Channel Estimation Using Sparse Momentum Fractional Adaptive Filter ...................... 549
Swetaleena Sahoo, Sarita Nanda, and Harish Kumar Sahoo

Real-Time Electromyographic Hand Gesture Signal Classification Using Machine Learning Algorithm Based on Bispectrum Feature ..... 559
Deepa Nair, R. Rajapriya, and K. Rajeswari

Design of Microwave Filters Using Swarm-Based Optimization Techniques ...................................................... 565
Piali Chakraborty, Arindam Deb, and Jyoti Ranjan Panda

Author Index ................................................................ 573
About the Editors

**Prof. Sukanta Kumar Sabut** received the B.E. and M.Tech. degrees in Electronics Engineering from the VT University of Karnataka in 2005 and the Ph.D. degree in Medical Science and Technology from IIT Kharagpur, India, in 2011. Presently, he is working as Associate Professor in the School of Electronics Engineering, KIIT Deemed to be University, Bhubaneswar, Odisha, India. Dr. Sabut is a member of IEEE, IET, IFESS, Rehabilitation Council of India, and the Institution of Engineers (India). He is the author of 75 articles in journals and conferences having Google scholar citations of 872. He has over 20 years of experience in both teaching and research. His research interests include biomedical signal and image analysis, machine learning and deep learning for health care, and neural and rehabilitation engineering.

**Prof. Arun Kumar Ray** is currently working as Professor and Director, School of Electronics Engineering and KIIT Deemed to be University. He is now involved both in teaching and administration. He has completed his Ph.D. from IIT Kharagpur. He has been with KIIT since the last 21 years. He has published many research papers in peer-reviewed international/national journals and conferences. He is also having active memberships of IEEE Signal Processing and IET and lifetime member of ISTE. During his teaching professional, he had taught subjects like digital signal processing, digital image processing, and computer networking. His research interest includes image processing and computer networks.

**Prof. Bibudhendu Pati** is Head in the Department of Computer Science, Rama Devi Women’s University, Bhubaneswar, India (Only Government Women’s University in the state of Odisha, India). He received his Ph.D. degree from Indian Institute of Technology Kharagpur, India. He has around 22 years of experience in teaching and research. His areas of research interests include wireless communication, cloud computing, big data, Internet of things, and advanced network technologies. He has got several papers published in reputed journals, conference proceedings, and books of international repute. He was General Chair of ICACIE 2016, IEEE ANTS 2017, ICACIE 2018, and ICACIE 2019. He is the life member of Indian Society for Technical Education, Computer Society of India, and a senior member of IEEE.
**Prof. U Rajendra Acharya** is a senior faculty member at Ngee Ann Polytechnic, Singapore. He is also (i) Adjunct Professor at the University of Malaya, Malaysia, (ii) Adjunct Faculty at Singapore Institute of Technology, University of Glasgow, Singapore, and (iii) Associate Faculty at Singapore University of Social Sciences, Singapore. He received his Ph.D. from National Institute of Technology Karnataka (Surathkal, India) and D.Eng. from Chiba University (Japan). He has published more than 630 papers, in refereed international SCI-IF journals (345), international conference proceedings (42), books (17) with 26,681 citations in Google Scholar (with h-index of 76), and ResearchGate RG Score of 47.76. Presently, he is Editor of *Knowledge-Based Systems Journal, BME Online Journal, International Journal of Neural Systems* etc. His major academic interests are in biomedical signal and imaging processing, data mining, and biophysics for better healthcare systems. He is ranked in the top 1% of the Highly Cited Researchers (2016 and 2017) in Computer Science according to the Essential Science Indicators of Thomson.
Academic Students Attendance System: A Case Study of Alexa Skill Development


Abstract ‘Alexa’ which is developed by Amazon Lab 126 is an intelligent virtual assistant used to improve the user’s comfort. Its expanded technology and modern range of facilities empowers the users to connect the different things wirelessly. Due to its compatibility with Android and iOS platform and ever growing applications, peoples are using Alexa as a house assistant. It is able to respond numbers of voice commands like maintaining to-do-list, alarm setting, controlling electrical appliances, providing world information. It can also be used as a gateway device which accepts the voice commands coming from different IoT enabled devices. Generally, upon requesting, the task performed by Alexa is called ‘Alexa Skills’ which is essentially a voice-driven Alexa app. In this work, the basics of Alexa skill development is discussed by building a simple custom skill called ‘Academic Students Attendance System’ which can be implemented in any educational institution where the number of students present in the class can be obtained from the voice command.

Keywords Alexa · Skill development · Hotword · Amazon · Lambda server

K. P. Swain (✉) · G. Palai
Department of Electronics and Communication Engineering, GITAM Institute of Technology, Bhubaneswar, India
e-mail: kaleep.swain@gmail.com

S. R. Samal
Faculty of Telecommunications, Technical University of Sofia, Sofia, Bulgaria

I. S. Amiri
Computational Optics Research Group, Advanced Institute of Materials Science, Ton Duc Thang University, Ho Chi Minh City, Vietnam

M. N. Mohanty
Department of ECE, I.T.E.R., SoA University, Bhubaneswar, India

© The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2021
S. K. Sabut et al. (eds.), Proceedings of International Conference on Communication, Circuits, and Systems, Lecture Notes in Electrical Engineering 728, https://doi.org/10.1007/978-981-33-4866-0_1
1 Introduction

Voice technology has travelled a long distance from performing a simple task to controlling different things, and most importantly, it is easier than a mobile app. So in the coming future, it will play a vital role to become a next big thing. Every year the selling of Alexa from Amazon is exponentially growing. Once it is set up (first time) by the help of a mobile app from an Google app or Apple app store, it can be operated flawlessly through a Wi-Fi network. It has many advantages over a mobile app like; fastest way of operation, hands free and multitasking experience, achieved task by keeping away from the mobile screen, optimal choice for blind and hand disabled persons and appropriate for old or uneducated people who finds tough to work with the smartphone. Some of the cotemporary voice control devices are Cortana (Microsoft), Siri (Apple) and Google Assistant (Google). Alexa is an artificial intelligence personal assistance made by Amazon. It powers Alexa echo and Alexa Echo dot smart speakers. The Alexa smart speaker is a hardware device with speakers and microphone built into it. It has audio processing unit which converts analogue audio signals into digital audio. The audio is then transferred to Amazon (AWS) servers to further process it. The digital audio signals are first converted into text using speech to text software, and then, the meanings are extracted using natural language processing software. Alexa starts listening to user commands by detecting hot word. For example, ‘Alexa’ is a hotword following which commands can be spoken for actions to be performed. Some of the literatures which are involved in some application related to Alexa skill are discussed in [1–6].

In [1], an intelligent virtual assistant Alexa’s ecosystem using a wireless smart speaker is discussed for forensics application. In the system, both mobile and Web application are developed to support the digital examination where wireless smart speaker acts as gateway for Alexa. An attendance system is developed in [2] which is worked on real-time basis using Alexa where inputs are taken from the students after Alexa is initialized by teacher. A local server (Raspberry Pi) is also used which acts as a real-time database to update the students attendance. The entire processing along with the authentication is taken care by Alexa skill sets. A review is conducted in [3] to obtain the customer reaction (emotion analysis) about the voice interactive devices which are used for home application. More than one lakhs of samples are collected regarding customer emotion by considering Amazon Echo and DNight MagicBox, and it is found Amazon Echo is very popular among the people where it is treated as a family member. A study is carried out in [4], whether the data collected by Alexa or similar type of device can be placed before the law enforcement body or not and it is revealed from the forensic analysis that the footprint of these type of devices can be used as a proof in the court of law. The alertness for patients whom are suffering from FITS seizure is performed by using Alexa along in companion with IoT devices [5]. Here, with the help of sensors equipped in IoT, wearable gadget senses the patient condition and accordingly transmits the voice signal to the patient, and if the sensors do not receive any return message from the patient, then the gadget raises the alert to different concern body. An extension of home automation with
more security features is discussed in [6] where the front door of a home is operated by Alexa. These facilities can be performed remotely by a smartphone, and also, the status of a door (open or close) can be read through the phone with the help of a local server like Raspberry Pi.

2 Basic Working Principle

Figure 1 demonstrates the basic working principle of Alexa where automatic speech processing along with natural language processing is used as in-build technology in Alexa to know the actual function of the voice command. Aside this, a cloud server is also used which executes the code with the help of lambda function.

Alexa skills are essentially programs with converted speech data to text data as input parameters by speech and language processing. There are a number of functions that can be programmed to perform specific tasks for specific commands. The function which performs an action on receiving command is known as ‘intent’. A skill can have multiple intents which maps to multiple speech commands. Intents can be defined in Alexa skill console through Internet, and intent can have multiple variants of a speech command which can be defined in the console. The intent is then passed to the programming environment where the programming environment is basically an Amazon lambda function. Amazon lambda functions are a part of AWS (Amazon Web server) service which is employed as a server less application. A lambda function takes in input as ‘http request’ and returns ‘http response’ to the client in case of a Web application or calls the other application program interfaces (APIs) and returns a speech response in the form of JavaScript Object Notation (JSON) object in case of an Alexa skill. Amazon provides skill development in Python and JavaScript at the time of coding.

![Fig. 1 Demonstration of Alexa working principle](image)
3 Implementation

In this case, REST-representational state transfer (RESTful) API is extensively used for the development of entire application. Here, the storage of data is carried out in EpsumThings server, and business logic is executed in AWS lambda. Both of the systems are kept in synchronization through RESTful API. REST API is essentially a request and response model from client and server, where client (lambda function in this case) sends request to the server, and response is sent back from server after the operation is successful.

The implementation of the attendance system is done as per the flow diagram shown in Fig. 2. At the first step, Alexa skill is created through Alexa skill console where developer can choose whether to use the backend at their own server or use Amazon lambda function. In this case, the backend is implemented on AWS lambda. After selection of skill development backend, intent definition is presented where speech intents can be defined. It can be implemented either by graphical user interface or bulk intents by using JSON objects. Intent can have multiple hotwords which can be defined in the console to perform a same action for a set of keywords or sentence. Once the intents are defined, they are connected with backend program using lambda function. Here, the backend program is using Alexa skill API to receive parameters parsed from the voice intent and passed to the backend functions. In this case, Python is used as the backend language which takes the parsed parameters as function arguments and string is returned as voice response to the user.

Figure 3 indicates the data flow between Alexa and a local server through API. In this case, the data about the attendance is stored in the EpsumThings platform which is updated using a simple API call. Here, EpsumThings is the name of online cloud server which is used to store the daily attendance data. The data stored in the platform is then pulled using REST API provided by EpsumThings platform through a simple ‘GET’ request. The attendance is represented by a number which shows number of students present in the class. When a professor asks Alexa using hotword ‘What is today attendance’ to know about the present attendance, the Alexa sends the sound signals to the Amazon skill server which in turn parses the audio signal into text. The text is then sent to the AWS lambda for processing. The lambda function gets the parameters as payload and calls API to get the attendance data from EpsumThings server and responds the user as speech about the attendance of the class. As the
above procedure cannot be represented in text, so the above block diagram (Figs. 2 and 3) is used to represent the entire process. In this process, one has to count the number of students present in the class and update the database in regular basis. Also, sometimes the process can be failed due to any server or network error.

4 Conclusion

A basic attendance system is successfully developed using Alexa skill development in this work which can send the voice answer about the daily student attendance after being asked by any person. Here, EpsumThings (online server) is used to store the daily attendance using API at each day. Upon using the hotwords ‘what is today attendance’, the intent is passed to the AWS lambda function by Alexa for processing. Then, the attendance data which is stored in the ‘EpsumThings’ server is fetched to Alexa, and at last, Alexa is responded the answer through the voice message.

References


Implementation of Low-Cost and Low-Power-Based Temperature and Air Quality Monitoring System for a Local Area in Odisha

Rudra Swarup Sahoo, Umakanta Samantasinghar, Adyasa Priyadarsini Acharya, and Priyabrata Biswal

Abstract   Environmental pollution is a major issue for public health and safety. Air contamination is one of the inherent causes of environmental issues. The reported monitoring and tracking systems have low precision, low sensitivity, and demonstrated laboratory scaled devices which cannot be accessed by the public. Therefore, improved observatory systems are highly essential. To overcome the limitations of reported systems, we propose a three-step air pollution monitoring system, where we can evaluate the data in three stages, that is a public display, website, and mobile application. An IoT kit was prepared using the MQ-135 Gas sensor, DHT11, LCD, and NodeMCU. We have deployed our developed system in our institution to provide local awareness among the general public and academic individuals as well as a platform for research and development under the smart city application. We can also monitor the data such as temperature, humidity, dew point, air quality index on a website so that individuals will be able to acquire relevant data from the database. A normal user or a person suffering from respiratory disorder is also capable of monitoring the data and will be able to take the required actions to prevent the upcoming unwanted situations. The power consumption and cost of the proposed system are the two important features of any modern devices. Hence, the authors here also give a sight of the power consumption as well as prospective of powering IoT devices through energy harvesting, which is not discussed in many reported literatures.

Keywords   Air quality index · Sensors and IOT · Energy harvesting · Low-power experimental set-up · Power consumption
1 Introduction

The sensors and actuators are actively participating in the field of structural health monitoring, air quality monitoring in smart city applications as well as human activity monitoring. Air pollution is one of the largest problems which has a drastic impact on the environment. Air is getting contaminated because of the release of toxic gases by different organization, increased vehicles, and exponential rise in concentration of harmful gases and particulate matters [1], which in affecting human as well as animal health. There are some factors present in the air like oxygen, ozone, carbon dioxide, carbon monoxide, methane, ammonia, particulate matter, etc. [2]. Air pollution causes harmful diseases like asthma, which motivates researchers to monitor the air quality and analyse of real-time data. The current work demonstrates a real-time air quality observatory system which is IoT enabled. This technology is playing a very useful pillar in our air quality monitoring system.

As shown in Table 1, there are many authors with their models that show different types of parameters of the air to calculate the air quality value. The parameters that are listed in the table can be easier to understand for the experts, but it is not that easy for a simple citizen. The reported monitoring system consumes high power and expensive. Some need costly sensors and some costly software to monitor this big amount of data. These models consuming more power also which is also a disadvantage. Many of these models cover a larger area like a smart city [3], and some also cover out of the city data [4]. Some mobile models can move from one location to another using Drone [5] and GPS [6]. To measure air quality, there is an air quality index (AQI) which is different according to the country. As per Central Pollution Control Board

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Parameters analysed</th>
<th>Power consumption (mW)</th>
<th>Total cost (INR) (k)</th>
<th>Application area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CO, CO₂, PM, NO₂, SO₂, O₃</td>
<td>1712</td>
<td>495</td>
<td>Specific areas</td>
</tr>
<tr>
<td>2</td>
<td>PM, CO, CO₂, Temperature, humidity, pressure</td>
<td>16,370</td>
<td>5</td>
<td>Outdoor</td>
</tr>
<tr>
<td>3</td>
<td>Temperature, humidity, dust CO, O₃</td>
<td>2620.45</td>
<td>4.5</td>
<td>Wide area</td>
</tr>
<tr>
<td>4</td>
<td>PM</td>
<td>15,595</td>
<td>6 k</td>
<td>Academic</td>
</tr>
<tr>
<td>5</td>
<td>O₂, O₃, CO, CO₂, NO₂, NH₃, CH₄</td>
<td>3010</td>
<td>20.2</td>
<td>Large area</td>
</tr>
<tr>
<td>6</td>
<td>SO₂, NO₁, O₃, CO, PM, VOC</td>
<td>1205</td>
<td>3.2</td>
<td>Outdoor</td>
</tr>
<tr>
<td>7</td>
<td>CO₂, Temperature, VOC</td>
<td>750</td>
<td>3.03</td>
<td>Indoor</td>
</tr>
</tbody>
</table>
of India, if the data is between 0–50, PPM then it is good, if it is between 51 and 100, then satisfactory, 101–200 is moderate, and 201–300 is poor. More than 300 is very much unhealthy which is mainly found in coal mines [1]. The paper is organized as follows: Section 2 presents overall system describing different modules as well as how the data accessibility is efficiently improved. Section 3 discussed experimental results as well as power consumption of different modules and prospective of energy harvesting for the developed system. Finally, the Section 4 summarizes the current work.

2 Overview of the System

The current work focuses on low-cost cum low-power air quality observatory and accessing system that consumes a very less amount of power as 1.43 W and shows real-time data. Not only experts but also everyone can monitor the data. If we send the data to the cloud only, then only connected persons can monitor the data and the public cannot see this and they will not aware of the problem. So an LCD is connected to display the real-time sensor data in public purpose. This model is mainly designed for educational institutions. The students need a healthy environment so that they will be healthy physically and mentally. If an air quality monitor is installed on the campus, then it will keep providing the real-time data to the authorities in the database and the students on the LCD. This data can be stored and monitored in the database so that authorities can take the required steps. The overall block diagram of the air quality monitoring system is given in Fig. 1.

![Block diagram of overall system](image)
2.1 **NodeMCU Unit**

Here, we used the NodeMCU board because it is a low-cost open-source IoT platform. It is included with a WiFi chip which is mounted with the Microcontroller unit. We are utilizing this because of its low-cost, low-power consumption capability, and small compact size.

2.2 **DHT11 Sensor and MQ135 Sensor**

DHT11 senses two factors, temperature and humidity, using the substrate used in the sensor. We have calculated the dew point value using the relation between temperature and relative humidity as in (1) [7].

\[
T_d = T - \left(\frac{100 - RH}{5}\right)
\]  

(1)

where \(T_d\) is dew temperature (°C), \(T\) is the temperature (°C), and \(RH\) is relative humidity (%). MQ-135 is the sensor that can give the air quality data with proper calibration and air quality is measured in parts per million (PPM). We need to convert this to logarithmic value to get the data in PPM and is given in (2) [1], where \(X_{PPM}\) is the air quality value in PPM, \(y\) is the ratio of resistances, \(m\) is the slope, \(b\) is the y-intercept.

\[
X_{PPM} = 10^{\left(\log(y) - b\right) / m}
\]

(2)

2.3 **Data Storage and Accessibility**

The data has been monitored through smart modules and collected at the database through the IoT devices. We can see the real-time data of the sensor value live on the 20 × 4 LCD screen as well as the data will be stored in the Cayenne database.

3 **Experimental Set-Up and Discussion**

3.1 **Experimental Procedure**

As shown in Fig. 1, the individual modules are initially tested and then interfaced with each other using Arduino. The power supply to the individual systems is given through battery. However, the devices can be powered through different energy harvesting techniques. The experimental set-up along with prototype, which has been
commissioned in the premises of B.J.B College (academic), Bhubaneswar, is illustrated in Fig. 2. The power consumption of different modules has been experimentally observed and is given in Table 2.

### Table 2  Power consumption of different modules

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Component used</th>
<th>Characteristics/feature</th>
<th>Min. Operating conditions</th>
<th>Power consumption (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Voltage (V)</td>
<td>Current (mA)</td>
</tr>
<tr>
<td>1</td>
<td>NodeMCU</td>
<td>Microcontroller and WiFi chip</td>
<td>5</td>
<td>160</td>
</tr>
<tr>
<td>2</td>
<td>LCD</td>
<td>Output display</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>DHT11</td>
<td>Temperature and humidity</td>
<td>3.3</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>MQ-135</td>
<td>Air quality</td>
<td>5</td>
<td>50</td>
</tr>
</tbody>
</table>

#### 3.2 Results and Discussion

The data from sensor module can be continuously analysed and monitored for $24 \times 7$ h. For manifesting the characterization of different parameters such as temperature, humidity, dew point, and air quality index, a group of data has been considered for a particular day starting from 10 a.m. for 24 h. It can be seen from the Fig. 3a–c the temperature and humidity were changing according to time and weather and dew point according to temperature and humidity. We noticed that the humidity was constant after 10:00 p.m. This condition affected the dew point graph. It can be obvious from Fig. 3a–c, the graph looks very much similar after 4:00 a.m., but there is a difference of 2–3°C found between temperature and humidity. We can see the data on air quality in PPM in Fig. 3d, where the value stays under 20 PPM throughout
the day, and at 2:00 p.m., it was higher for some reason. It can be dust or any kind of gas exposed to it. As per the AQI, if the value is under 50, then it is good for everyone. The data we got is under 40, so we can say that the air is not polluted. The accuracy of temperature, humidity, dew point, and air quality index in terms of standard deviation of measurement results are found to be $\pm 0.286$, $\pm 2.77$, $\pm 0.563$, and $\pm 0.436$, respectively. In our developed system, the modules get powered from the battery. However, it is proposed to develop some energy harvesting modules based on piezoelectric and or photovoltaic to harvest the required amount of power such as minimum of 1.432 W. There are widely explored literatures on energy harvesting prospective which can be explored for our work [8, 9].

4 Conclusion

In this work, we have demonstrated a low-cost air quality monitoring system, whose power consumption is also very low and is accessible by general public use and or researchers. The power consumption of individual units as well as from energy harvesting prospective as a future work has also been presented, which has not been discussed in many literatures. This work gives a roadmap for researchers to work on low-power applications as well as to integrate the energy harvesting modules to any activity monitoring systems.
References

Comparison Between LSTM and RNN Algorithm for Speech-to-Speech Translator

Bageshree Pathak, Shipra Mittal, Komal Shinde, and Pranjali Pawar

Abstract This paper presents the implementation of a speech-to-speech translator using python that can overcome the barrier of different languages. The user can speak in Marathi which will be taken as the input and output will be the translated speech in English. The proposed methodology may be used to bridge the language barrier between a doctor and patient in a rural scenario. The machine learning model used here is sequence-to-sequence model. Keras layers are used which includes encoding, dense, RNN.

Keywords RNN · Speech-to-text · Text-to-text · Text-to-speech

1 Introduction

India is a diverse country having about 22 constitutionally approved languages. Around 1650 dialects are spoken by different communities. As per 2011 Census, the average Indian literacy rate is 69.30%. Fewer than 5% people can read/write English. Two languages that are English and Hindi are regarded as the official languages of India. These languages were made official, so that there can be some common languages which can be used to communicate all over India in common. But, being a democratic country, the languages were not imposed on everyone. So, there are still places all over the country where people only know their local language, and when there is a need, they are not able to communicate with the people outside their region and even the digital media is mostly present in English. All these things make it necessary to have a language translator.
So, the purpose of this translator is to get over the language barrier and also the technology barrier. To be specific, we are sticking to a rural scenario where a doctor and patient need to talk with each other and both are unaware of each other’s language. In this way, the project is contributing to the society as well.

This translator system can further be extended to include more languages, so that the translator is more usable.

2 Literature Survey

There are four modules in [1], namely voice recognition, translation, speech synthesis, and image translation. The translated language is converted to audio and is given as the output. This application can also accept written text and can convert it into the required language. This application is also enabled to recognize any text present in the image which can be stored in the system or can be captured by making use of camera and translate the text into the desired language. The translation can be displayed on the screen.

Debnath et al. [2] is used for conversion of English text to speech of multiple languages. Input is given by the user as English text to GUI or images of text, and the output is given as translated speech in different language with the help of OCR technique. This methodology can be used to assist people lacking speech or the non-native speakers.

In [3], translation of text is done by a computer without human intervention. Machine translation is a part of NLP that aims to change text/speech of one natural language to another with the help of software. An automatic translation system is built for conversion of text from English to Hindi.

In [4], translation is done by using automated computing. This reviewed various important machine translation system and present comparison of the core technology.

Hermanto et al. [5] presents a comparison between neural-based network that uses RNN and statistical-based network for Indonesian to English and vice versa machine translation. The perplexity value evaluation of both the models is done. The result shows that the use of RNN obtains a much better result. Also, BLEU and RIBES values were found to be increased by 1.1 and 1.6 higher than those obtained using statistical based.

3 Methodology

The implementation is done in three phases:

1. Speech recognition
2. Text-to-text translation
3. Text-to-speech conversion (Fig. 1).
3.1 **Speech Recognition**

This block is responsible for speech recognition and then converting the speech to text. Firstly, the mic is configured, and then, the chunk size is set which is nothing but the bytes of data that we want to read at once. Then, the sampling rate is decided, and this tells us how often the values are recorded for processing. Since the surrounding noise is variant, the program is allowed some time to adjust its energy threshold of recording, so that it is adjusted in accordance to the external noise level. Finally, the speech is converted to text. All these functions are accomplished with the help of Google Speech-to-Text API.

3.2 **Text-to-Text Translation**

This block is responsible for converting the text output from the previous block (i.e., Marathi) to the other language (i.e., English). It makes use of the neural machine learning model created with the help of Keras library. The steps followed are shown in the flowchart (Fig. 2).

**Dataset** There is essentially a dataset present in the form of a text file. The file contains pair of Marathi and their translated counterparts in English. This is the dataset that is used for training (80%) and testing (20%). The file is read and is followed by text cleaning, i.e., punctuations removed, uppercases converted to lowercase. The size of total dataset is 38,008 sentences.

**Text-to-Sequence Conversion** Now, to convert the text to sequence, first the maximum length of sentences in each language is determined by plotting histogram. Then, the text (training and testing) data is vectorized using Keras Tokenizer() class individually for each language set.

**Encoder, Decoder Layers** The first layer is embedding which is used to convert positive into dense vectors of fixed size. This is the form that deep neural network can understand. Dense representation helps in capturing words relation. In this representation, words with similar meanings are kept closer to each other in the vector space. There are two RNN layers present, the first one encodes. Encoding is done to convert the sequence of symbols into a fixed length vector representation. The second one decodes. Decoding means converting the representation into another sequence of symbols. It applies the activation function on the output.