NLoS-VICINITY: A **N**on-**L**ine **o**f **S**ight Approach for **V**isible L**I**ght **C**ommunication based **IN**door Pos**IT**ioning S**Y**stem

Dhivya G, Hariharan K, Sayantani Bhattacharya, Poonguzhali P, Vaibhav M, Lokeshwar S

Centre for Development of Advanced Computing (C-DAC), Chennai, India

dhivyag@cdac.in, hariharank@cdac.in, sayantanib@cdac.in, poonguzhalip@cdac.in, vaibhavm@cdac.in, lokeshwars@cdac.in

***Abstract*—In recent years with the rapid development of wireless communication technologies, positioning the person inside a building and providing various indoor location-based services have gradually penetrated in our daily life. Radio frequency (RF) based positioning techniques such as Radio Frequency Identification (RFID), Bluetooth and Wi-Fi plays a major role in indoors as GPS is unreliable in interior spaces because of the attenuation faced by the satellite signals. But RF based solutions require additional devices to position the user which in-turn increases the infrastructure cost. Among the optical Wireless Communication (OWC) technologies, Visible Light Communication (VLC) can be an alternative to RF based positioning with little modification in existing lighting infrastructure. VLC combines illumination and communication thereby saving energy and cost. Unlike RF based positioning systems, VLC based positioning requires Line of Sight (LoS) to establish communication between transmitter and receiver which may create user discomfort. A novel user comfort enabled solution using Non-line of Sight approach has been developed to position the user in an indoor environment using VLC. This paper explains the challenges existing in LoS based positioning approach, our proposed system and presents the results of experimental analysis.**

***Keyword*— Indoor Positioning System (IPS), Non-Line of Sight (N-LoS), Optical Camera Communication (OCC), Optical Wireless Communication (OWC), Visible Light Communication (VLC)**

Dhivya G obtained her M.E in Embedded Systems Technologies from College of Engineering, Guindy, India. She holds 2 Indian patents, 1 copyright and 5+ international publication to her credit. She has filed 3 Indian patents. She is associated with Centre for Development of Advanced Computing (C-DAC) Chennai for past 16+ years. Currently she is designated as Joint Director. Her areas of interest include Visible Light Communications, Internet of Things, Wireless Sensor Network and Cyber Security

Hariharan K holds M. Tech degree in Electronics Design Technology from National Institute of Electronics and Information Technology (NIELIT), Calicut, India. He is associated with C-DAC Chennai for past 3+ years as Project Engineer. He has filed 2 Indian patents. His areas of interests are Electronics System Design, Hardware Engineering and Product Design.

Sayantani Bhattacharya has been associated with C-DAC for the last 14+ years. Currently, she is designated as Joint Director. She filed an Indian patent, holds 2 copyrights and 5 International publications to her credit. Her areas of interest include Internet of Things (IoT), Ubiquitous Computing, Wireless Sensor Network & applications, Context Aware Computing, and Visible Light Communications.

Poonguzhali P is currently designated as Joint Director at C-DAC with 16+ years of experience. She received her B.E (ECE) from Anna University and MS (Research) in ECE from JNT University. She holds 3 Security certifications: CEHv7, ECSAv8 and GSSP-Java. Her areas of expertise are Internet of Things (IoT), Mobile Security, Android platform, Progressive Web Apps (PWA), Ubiquitous Computing, Wireless Sensor Networks (WSN), Enterprise Java Application development and Middleware technologies. She has filed an Indian patent, holds 6+ research publications and 1 Copyright.

Vaibhav M received B.Tech in Mechanical Engineering from Rajasthan Technical University, India. He is associated with C-DAC for past 3+ years as Project Engineer. His areas of expertise are mechanical design, electronics assembly and 3D printing.

Lokeshwar S holds M.E. (Embedded System Technologies) from Anna University, Chennai India. He is associated with C-DAC for past 3+ years as Project Engineer. His areas of expertise are Sensor interfacing, IoT, PCB design and NDT Testing.