

Development of a Real-Time Radial Scanning System for Object Surveillance

MD. Muslim Uddin

Department of Electrical & Electronic Engineering
World University of Bangladesh
Dhaka, Bangladesh
mdmuslimkhan107@gmail.com

MD. Sharif Uddin Shajib

Lecturer
Department of Electrical & Electronic Engineering
World University of Bangladesh
Dhaka, Bangladesh
Sharif.uddin@eee.wub.edu.bd

Mohammad Quamruzzaman

Professor and Head
Department of Electrical & Electronic Engineering
World University of Bangladesh
Dhaka, Bangladesh
md.quamruzzaman@eee.wub.edu.bd

Md. Riyad Tanshen

Associate Professor
Department of Electrical & Electronic Engineering
World University of Bangladesh
Dhaka, Bangladesh
tanshen@eee.wub.edu.bd

Sumi Akter

Lab Assistant
Department of Electrical & Electronic Engineering
World University of Bangladesh
Dhaka, Bangladesh
sumi.akter@eee.wub.edu.bd

Abstract

Radar (Radio Detection and Ranging) is a foundational system for remote sensing, utilizing radio waves to accurately determine the range, velocity, altitude, and bearing of external targets. This research project aimed to develop a cost-

effective and efficient proof-of-concept radar system utilizing accessible components and reflecting established radar principles. The proposed system, designated as an ultrasonic radar for target detection and velocity measurement, was implemented on the Arduino microcontroller platform. It employs an ultrasonic transceiver module to emit a focused 40 kHz ultrasonic pulse. The sensor module is mechanically scanned using a stepper motor across defined angular intervals. Target range is determined through a time-of-flight calculation, measuring the interval between pulse transmission and echo reception. An estimation of the target's radial velocity is achieved by analyzing the observed shift in the detected signal's position over time, with all spatial and kinematic data synthesized and visualized on a Plan Position Indicator (PPI) display interface. The results demonstrated that the implemented system successfully verified the principles of low-cost ultrasonic radar. It achieved its objectives by reliably detecting both fixed and moving targets and accurately measuring their distance and angular position within the coverage area. In conclusion, this work validates the feasibility of creating an efficient and inexpensive radar demonstrator based on the Arduino platform and ultrasonic technology, offering a robust solution for target detection and basic speed measurement in contexts where traditional radar is cost-prohibitive.

Keywords

Arduino, Ultrasonic Sensor, Radial Scanning, Object Detection, Real-Time, Low-Cost Surveillance.

Biographies

Md. Muslim Uddin is an aspiring electrical and electronic engineer currently pursuing his Bachelor of Science (B.Sc.) degree in Electrical & Electronic Engineering at the World University of Bangladesh (WUB), Dhaka, Bangladesh. His academic and research interests focus on embedded systems, microcontroller programming, and low-cost sensor technologies. He specializes in developing practical prototypes that translate theoretical engineering concepts into real-world applications. His final-year project, detailed in this paper, involves the "Development of a Real-Time Radial Scanning System for Object Surveillance" using the Arduino platform, reflecting his strong interest in real-time data acquisition, radial scanning systems, and graphical data visualization. He is eager to pursue advanced studies and a professional career in industrial automation and smart device development.

Md. Sharif Uddin Shajib is a Lecturer in the Department of Electrical and Electronic Engineering at the World University of Bangladesh (WUB). He earned his B.s c. in Electrical & Electronic Engineering (2015) and his M.Eng. in Telecommunication Engineering (2025), both from WUB. His academic journey includes roles as Senior Lab Assistant (2016–2020) and Teaching Assistant (2020–2023) at WUB, during which he developed strong expertise in laboratory instruction and curriculum support. His research focuses on resource allocation in photonic systems, wireless communication and the evolution from 5G to 6G networks, with emphasis on simulation-driven design and performance analysis. In teaching, he covers undergraduate courses such as Electrical Circuits, Digital Electronics, Communication and Electrical Service Design, and he contributes to curriculum development and laboratory modernization initiatives. He is also Advisor, IEOM Society WUB Student Chapter.

Prof. Dr. Mohammad Quamruzzaman serves as Professor and Head of the Department of Electrical & Electronic Engineering at the World University of Bangladesh (WUB). He first joined WUB in February 2008, worked until February 2011, and re-joined the university in November 2021. He holds a BSc. Engineering (EEE) from John Moore University, Liverpool, U.K., and both MSc and PhD degrees from the Department of EEE, Faculty of Engineering & Technology, University of Dhaka. Before his academic tenure, he spent 29 years at the Bangladesh Atomic Energy Commission (BAEC) in various senior roles including Chief Engineer, Director and Director General, retiring as a Member (Engineering). His current research investigates the effects of electromagnetic radiation (EMR) on living systems and the environment from sources such as communication equipment (cell phones, towers); to date around 30 student projects and 18 international publications have been completed. He is a Fellow/Member of several professional bodies including the Institute of Engineers Bangladesh (IEB), Bangladesh Electronic & Informatics Society (BEIS), and the Institution of Electrical Engineers (IEE), London

Dr. Md. Riyad Tanshen is an Associate Professor in the Department of Electrical and Electronic Engineering (EEE) at the World University of Bangladesh (WUB). He obtained his B.Sc. in EEE from WUB, and his M.Eng. and Ph.D. degrees in Energy and Mechanical Engineering from Gyeongsang National University, South Korea. Dr. Tanshen's research interests include oscillating heat pipes, geothermal and wind energy, nanofluids, and computational fluid dynamics (CFD). He has published over 59 research papers in international journals and conferences and received

several awards in South Korea, including the Cooling & Heating Technologies Forum. He is an active member of IEEE and the Asiatic Society of Bangladesh.

Mst Sumi Akter

Mst Sumi Akter is an Electrical and Electronic Engineering (EEE) professional from Bangladesh, currently working as a Lab Assistant at the World University of Bangladesh since 2019. She holds a Bachelor's degree in Electrical and Electronic Engineering from the same university and a Diploma in Electronics from Comilla Polytechnic Institute. Her role involves managing laboratory operations, assisting in research, and guiding students in practical experiments. Previously, she served as a teacher at the Genetic Polytechnic Institute, where she mentored students in technical disciplines. Her research interests include power electronics, renewable energy, artificial intelligence, and cybersecurity. She has contributed to several publications on energy management and smart engineering systems. Sumi is also an active organizer at the WUB EEE Club, promoting student engagement through workshops and events. In 2023, she received the Outstanding Young Faculty Award from the IEOM International Conference. She enjoys reading, traveling, and swimming.