DOI: 30.7217/ijearst.21.58.2027 https://ijearst.co.in/

ENGINEERING IN ADVANCED RESEARCH SCIENCE AND TECHNOLOGY

ISSN 2386-7876
Vol.01, Issue.03
March-2026
Pages: 426-429

A NON-GPS BASED LOCATION TRACKING OF PUBLIC BUSES USING BLUETOOTH PROXIMITY BEACONS

[1] **S.Raghava Rao**, [2] **Koppisetti Hemasri**, [3] **Yellamilli Suma**, [4] **Vulise.A.S.V.Lakshmi**, [5] **Mendu Abhinesh Varma**
[1]M.Tech(Ph.d),Associate professor, Dept of E.C.E, BVCITS, Batlapalem, Amalapuram, AP
[2,3,4,5]B. Tech, Dept of E.C.E, BVCITS, Batlapalem, Amalapuram, AP

Abstract Accurate tracking of public buses is essential for improving urban transportation efficiency and passenger convenience. However, GPS-based systems often face limitations such as signal loss in tunnels, dense urban areas, and increased power consumption. This work proposes a non-GPS-based location tracking system using Bluetooth Low Energy (BLE) proximity beacons to determine the real-time position of public buses. In the proposed system, BLE beacons are strategically deployed at bus stops or along routes, while a Bluetooth-enabled device installed in the bus continuously scans for nearby beacons. Based on signal strength (RSSI) and proximity estimation, the system determines the bus location and transmits the data to a central server via IoT communication. Passengers can access real-time bus location information through mobile applications or web interfaces. The system offers a cost-effective, energy-efficient, and reliable alternative to GPS-based tracking, particularly in environments where GPS signals are weak or unavailable. Experimental results demonstrate improved accuracy in short-range localization and reduced dependency on satellite-based systems, making it suitable for smart city transportation applications.

Keywords Bluetooth Low Energy (BLE), Proximity Beacons, Non-GPS Tracking, Public Transportation System, Indoor Localization, RSSI-Based Positioning, IoT-Based Tracking, Smart City, Real-Time Monitoring, Wireless Communication, Beacon Technology, Location-Based Services, Intelligent Transportation Systems.

INTRODUCTION: Tracking of public bus location requires a GPS device to be installed, and many bus operators in developing countries do not have such a solution in place to provide an accurate estimation of bus arrival time (ETA). Without ETA information, it is very difficult for the general public to plan their journey effectively. This paper proposes an innovative IoT solution to track the location of buses without requiring the deployment of a GPS device. It uses Bluetooth Low Energy (BLE) proximity beacon to track the journey of a bus by deploying an Estimate location beacon on the bus. BLE detection devices are installed at selected bus stops along the bus route to detect the arrival of buses. Once detected, the location of the bus is submitted to a cloud server to compute the bus ETAs. A field trial is currently being conducted in Johor, Malaysia in collaboration with a local bus operator on one single bus route. Our test results showed that the detection of BLE beacons is very accurate and it is feasible to track the location of buses without using a GPS device in a cost-effective way. A mobile app – my Busz has been developed as well to allow for passengers to check the bus ETA in real-time. Internet of Things is a concept where each device is assigning to an IP address and through that IP address anyone makes that device identifiable on internet. The Internet is an evolving entity. It started as the "Internet of Computers." Research studies have forecast an explosive growth in the number of "things" or devices that will be connected to the Internet. The resulting network is called the "Internet of Things" (IoT) [1]. IoT is having the potential to change the lifestyle of peoples. In day today's life, people prefer more of automatic systems rather than any manual systems. The major elements of IoT based home automation system are Arduino uno and the Relay along with their driving circuitry for respective functionality.

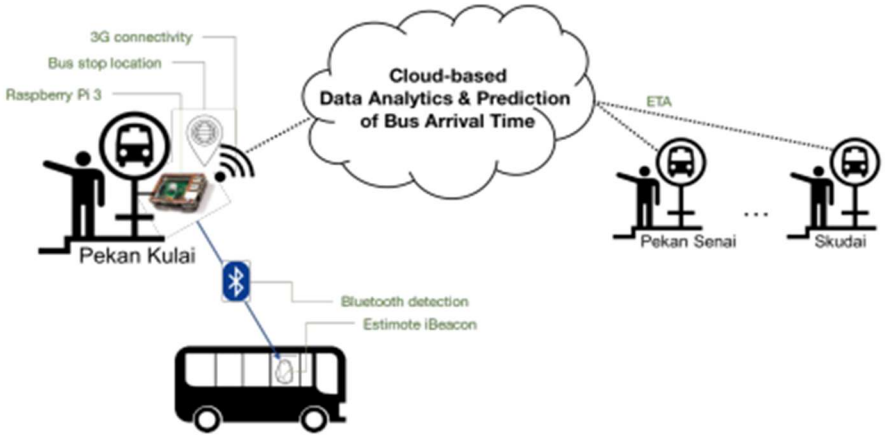

Fig. 1: Architectural overview of location tracking of public buses using BLE.

LITEARTURE SURVEY: This paper provides a simple introduction to the IoT, its application and potential benefits to the society [1]. IoT has received much attention from scientists, industry and government all over the world for its potential in changing modern day living. IoT is envisioned as billions of sensors connected to the internet through wireless and other communication technologies. The sensors would generate large amount of data which needs to be analyzed, interpreted and utilized [2]. Domestics System uses the technology of Internet of Things for monitoring and controlling of the electrical and electronic appliances at home from any remote location by simply using a Smartphone. Implementation of a low cost, flexible home automation system is presented. It enhances the use of wireless communication which provides the user with remote control of various electronic and electrical appliances [4].

SYSTEM DESIGN Arduino/genuino uno is a microcontroller board based on the atmega328p (datasheet). It has 14 digital input/output pins (of which 6 can be used as pwm outputs), 6 analog inputs, a 16 MHz quartz crystal, a usb connection, a power jack, an icsp header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a usb cable or power it with a ac-to-dc adapter or battery to get started. You can tinker with your uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino software (ide) 1.0. The uno board and version 1.0 of Arduino software (ide) were the reference versions of Arduino, now evolved to newer releases. The uno board is the first in a series of usbarduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

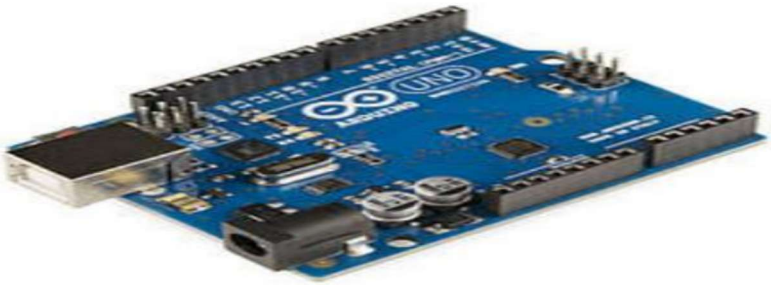

Fig.2. Arduino UNO.

The programming of the Arduino/genuino uno can be programmed with the (Arduino software (ide)). Select “Arduino/genuino uno from the tools > board menu (according to the microcontroller on your board). For details, see the reference and tutorials. The atmega328 on the Arduino/genuinouno comes preprogrammed with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original stk500 protocol (reference, c header files). You can also bypass the bootloader and program the microcontroller through the icsp (in-circuit serial programming) header using arduinoisp or similar; see these instructions for details.

HARDWARE IMPLEMENTATION:

To make the desired system function we designed a block diagram that functions as per the desired functionality.

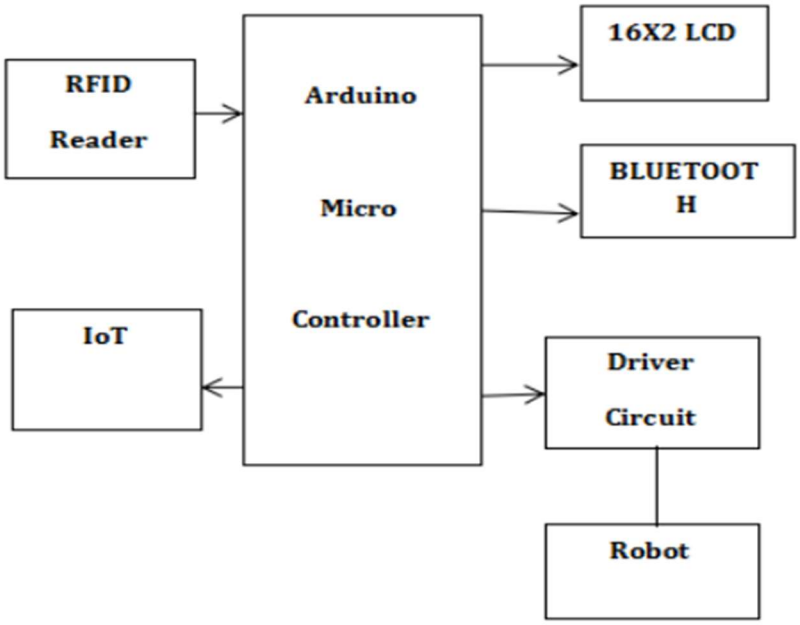

Fig.3. Block diagram of system.

In proposed system Arduino and Bluetooth modules used. Android application used to give the details of all buses in the network via Bluetooth.

Radio Frequency Identification RFID, short for Radio Frequency Identification, is a technology that enables identification of a tag (that is normally attached with an entity) by using electromagnetic waves. RFID Reader Module, are also called as interrogators. They convert radio waves returned from the RFID tag into a form that can be passed on to Controllers, which can make use of it. RFID tags and readers have to be tuned to the same frequency in order to communicate. RFID systems use many different frequencies, but the most common and widely used & supported by our Reader is 125 KHz.

FEATURES:

- Reading Distance: 6-10 cm
- Dimension: 40mmx20mmx8mm (LxHxW)
- Frequency:125kHz
- Compatible Card
- codes: Manchester 64-bit, modules64
- Current Rating: 35mA (Max)
- Operating Voltage:4.6V - 5.4VDC

BLUETOOTH:

Bluetooth is a wireless technology standard for exchanging data over short distances (using short wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices and building personal area networks (PANs). In 1994 a group of engineers at Ericsson, a Swedish company, invented a wireless communication technology, later called Bluetooth. In 1998, the original group of Promoter companies—Ericsson, Intel, Nokia, Toshiba and IBM— came together to form the Bluetooth Special Interest Group (SIG).

RESULTS:

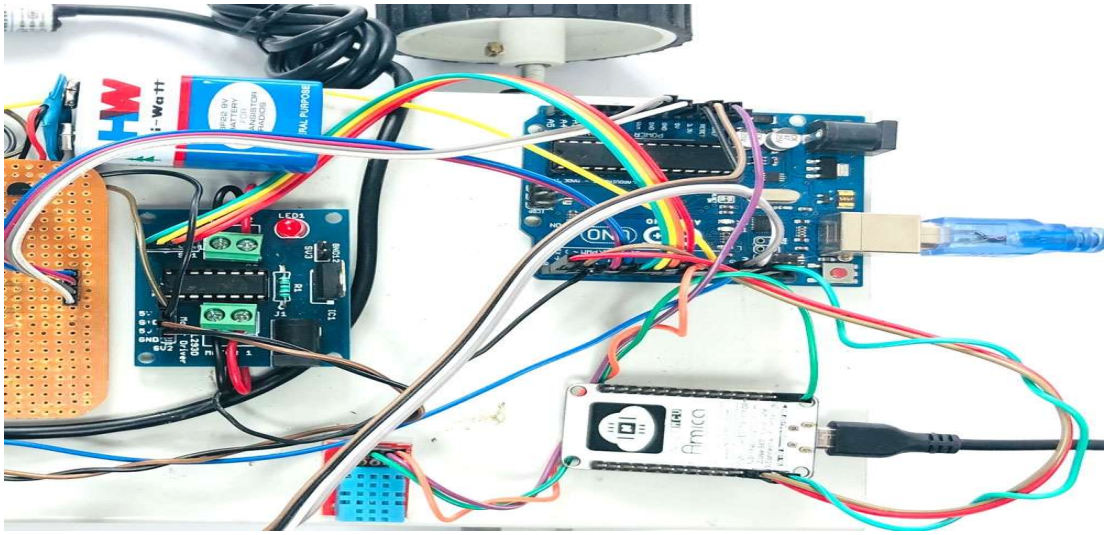

Fig a: Hardware prototype

Advantages

- Works Without GPS:
  Effective in tunnels, underground routes, and dense urban areas.
- Low Power Consumption:
  BLE technology ensures energy-efficient operation.
- Cost-Effective Deployment:
  Beacons are inexpensive compared to GPS infrastructure.
- High Accuracy in Short Range:
  Provides precise localization near bus stops and stations.
- Easy Installation:
  Simple setup of beacons and onboard devices.
- Scalable System:
  Can be expanded across large transportation networks.

Applications

- Public Bus Tracking Systems
- Metro and Underground Transport Monitoring
- Smart City Transportation

- Indoor Navigation Systems (Bus Terminals, Stations)
- Fleet Management Systems
- Passenger Information Systems
- Logistics and Asset Tracking

Conclusion

The proposed non-GPS-based bus tracking system using Bluetooth proximity beacons provides a reliable and efficient alternative to traditional GPS-based tracking methods. By leveraging BLE technology and RSSI-based localization, the system ensures accurate tracking even in GPS-denied environments such as tunnels and dense urban areas. The system enhances passenger convenience by providing real-time location updates and improves operational efficiency for transport authorities. Its low cost, scalability, and energy efficiency make it highly suitable for modern smart city applications. Overall, the approach offers a practical and robust solution for intelligent transportation systems.

Future Scope

- Hybrid GPS-BLE Integration:
  Combine GPS and BLE for improved accuracy and wide-area coverage.
- Machine Learning for Localization:
  Use AI models to improve RSSI-based distance estimation.
- Mobile App Development:
  Develop user-friendly applications for passengers.
- Integration with Smart Ticketing Systems:
  Link tracking with automated fare collection systems.
- 5G/IoT Connectivity:
  Enhance real-time communication with faster networks.

REFERENCES:

[1] N. B. Priyantha, A. Chakraborty, and H. Balakrishnan, "The cricket location-support system," in *Proc. ACM MobiCom*, 2000, pp. 32–43.
[2] P. Bahl and V. N. Padmanabhan, "RADAR: An in-building RF-based user location and tracking system," in *Proc. IEEE INFOCOM*, 2000, pp. 775–784.
[3] Bluetooth SIG, "Bluetooth Core Specification Version 5.0," 2016.
[4] S. He and S.-H. G. Chan, "Wi-Fi fingerprint-based indoor positioning: Recent advances and comparisons," *IEEE Commun. Surveys Tuts.*, vol. 18, no. 1, pp. 466–490, 2016.
[5] R. Faragher and R. Harle, "Location fingerprinting with Bluetooth Low Energy beacons," *IEEE J. Sel. Areas Commun.*, vol. 33, no. 11, pp. 2418–2428, Nov. 2015.
[6] Z. Chen et al., "Bluetooth low energy based indoor positioning," *IEEE Internet Things J.*, vol. 3, no. 6, pp. 1234–1245, 2016.
[7] M. Youssef and A. Agrawala, "The Horus WLAN location determination system," in *Proc. ACM MobiSys*, 2005, pp. 205–218.
[8] J. Torres-Sospedra et al., "Comprehensive analysis of distance and similarity measures for Wi-Fi fingerprinting indoor positioning systems," *Expert Syst. Appl.*, vol. 42, no. 23, pp. 9263–9278, 2015.
[9] A. Haeberlen et al., "Practical robust localization over large-scale 802.11 wireless networks," in *Proc. ACM MobiCom*, 2004.
[10] S. Gezici, "A survey on wireless position estimation," *Wireless Pers. Commun.*, vol. 44, no. 3, pp. 263–282, 2008.
[11] Y. Zhuang et al., "A survey of positioning systems using visible LED lights," *IEEE Commun. Surveys Tuts.*, vol. 20, no. 3, pp. 1963–1988, 2018.
[12] H. Liu et al., "Survey of wireless indoor positioning techniques and systems," *IEEE Trans. Syst., Man, Cybern.*, vol. 37, no. 6, pp. 1067–1080, Nov. 2007.
[13] M. Collotta et al., "A Bluetooth-based indoor positioning system for IoT applications," *IEEE Conf.*, 2018.
[14] K. Davidson and J. Pahlavan, "Hybrid positioning using Bluetooth and Wi-Fi," *IEEE Commun. Lett.*, vol. 18, no. 9, pp. 1547–1550, 2014.
[15] A. Kushki et al., "Fingerprinting-based indoor positioning using BLE beacons," *IEEE Sensors J.*, vol. 17, no. 12, pp. 3772–3782, 2017.