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PREDICTING BUS ARRIVAL TIME WITH MOBILE PHONE

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ABSTRACT

The bus arrival time is primary information to most city transport travelers. Excessively long waiting time at bus stops often discourages the travelers and makes them reluctant to take buses. In this paper, we present a bus arrival time prediction system based on bus passengers' participatory sensing. With commodity mobile phones, the bus passengers' surrounding environmental context is effectively collected and utilized to estimate the bus traveling routes and predict bus arrival time at various bus stops. The proposed system solely relies on the collaborative effort of the participating users and is independent from the bus operating companies, so it can be easily adopted to support universal bus service systems without requesting support from particular bus operating companies. Instead of referring to GPS enabled location information, we resort to more generally available and energy efficient sensing resources, including cell tower signals, movement statuses, audio recordings, etc., which bring less burden to the participatory party and encourage their participation. We develop a prototype system with different types of Android based mobile phones and comprehensively experiment over a 7 week period. The evaluation results suggest that the proposed system achieves outstanding prediction accuracy compared with those bus company initiated and GPS supported solutions. At the same time, the proposed solution is more generally available and energy friendly.

I. INTRODUCTION

The unpredictability of bus arrival times has long been a major challenge for public transportation systems worldwide. [1] Traditional methods of predicting bus arrival times, such as static schedules and driver-reported delays, often prove unreliable due to factors like traffic congestion, unforeseen incidents, and varying road conditions. [2] However, the advent of mobile technology and advancements in data science have opened up new avenues for addressing this issue. By harnessing the power of smartphones and sophisticated algorithms, researchers and developers are working to create innovative solutions that can accurately predict bus arrival times. [3] This transformative approach, often referred to as "predictive public transportation," has the potential to revolutionize the way we commute, making it more efficient, reliable, and convenient. Through the integration of GPS tracking, real-time traffic data, and machine learning techniques, mobile apps can provide passengers with accurate and up-to-date information about bus arrival times. [4] This empowers commuters to plan their journeys more effectively, reduce waiting times, and ultimately enhance their overall transportation experience. As technology continues to evolve, we can anticipate even more sophisticated and personalized solutions that will further optimize public transportation systems and improve the quality of life for millions of people.

II. LITERATURE SURVEY

Today's cyber-physical systems (CPS) increasingly operate in social spaces. Examples include transportation systems, disaster response systems, and the smart grid, where humans are the drivers, survivors, or users. Much information about the evolving system can be collected from humans in the loop; a practice that is often called crowd-sensing. Crowd-sensing has not traditionally been considered a CPS topic, largely due to the difficulty in rigorously assessing its reliability. This paper aims to change that status quo by developing a mathematical approach for quantitatively assessing the probability of correctness of collected observations (about an evolving physical system), when the observations are reported by sources whose reliability is unknown. The paper extends prior literature on state estimation from noisy inputs, that often assumed unreliable sources that fall into one or a small number of categories, each with the same (possibly unknown) background noise distribution. In contrast, in the case of crowd- sensing, not only do we assume that the error distribution is unknown but also that each (human) sensor has its own possibly different error distribution. Given the above assumptions, we rigorously estimate data reliability in crowd-sensing systems, hence enabling their exploitation as state estimators in CPS feedback loops. We first consider applications where state is described by a number of binary variables, then extend the approach trivially to multivalued variables. The approach also extends prior work that addressed the problem in the special case of systems whose state does not change over time. Evaluation results, using both simulation and a real-life case-study, demonstrate the accuracy of the approach.

Modern CPS applications increasingly operate in social spaces, where humans play an important part in the overall system. Hence, future applications should increasingly be engineered with an understanding of the humans in the loop. In this paper, we focus on the role of humans as sensors in CPS systems; a practice that is commonly known as crowdsensing [2]. Humans act as sensors when they contribute data (either direcltly or via sensors they own) that a CPS application can use. For example, drivers may contribute data on the state of traffic congestion at various locales, and survivors may contribute data on damage in the aftermath of a natural disaster. A challenge in this context is that data sources may be unreliable. In fact, the reliability of individual observers in crowd-sensing applications is generally not known [3]. A common thread in CPS research focuses on reliability of cyber-physical systems. Most research focused on two aspects of CPS reliability; namely, correctness of temporal behavior and correctness of software function. In order for crowdsensing to become a viable component in CPS feedback loops, one needs to understand correctness of collected observations as well. We call this latter challenge the data reliability challenge, to complement the challenges of timing reliability and software reliability mentioned above [1]. Consider a CPS application that uses crowd-sensing to collect data about a physical environment. The data reliability challenge refers to designing a state estimator that takes raw unreliable crowd-sensing data as input and outputs reliable estimates of the underlying physical state of the environment, as well as appropriate error bounds [5]. A growing number of mobile computing applications are centered around the user's location. The notion of location is broad, ranging from physical coordinates (latitude/longitude) to logical labels (like Starbucks, McDonalds). While extensive research has been performed in

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physical localization, there have been few attempts in recognizing logical locations. This paper argues that the increasing number of sensors on mobile phones presents new opportunities for logical localization [9]. We postulate that ambient sound, light, and color in a place convey a photo-acoustic signature that can be sensed by the phone's camera and microphone. In-built accelerometers in some phones may also be useful in inferring broad classes of user-motion, often dictated by the nature of the place [10]. By combining these optical, acoustic, and motion attributes, it may be feasible to construct an identifiable fingerpr[illegible]lization. Hence, users in adjacent stores can be separated logically, even wh[illegible]sitions are extremely close [8].

III. SYSTEM MODEL

A robust system for predicting bus arrival times involves a multi-faceted approach [4]. Real-time GPS tracking of buses provides accurate location data, while traffic sensors and mobile network data offer insights into current traffic conditions. Historical data on bus schedules, traffic patterns, and passenger usage is crucial for training machine learning models. [1] These models, such as regression models, time series forecasting, and neural networks, analyze the extracted features to predict arrival times. The system continuously updates predictions as new data becomes available, ensuring accuracy [6]. A user-friendly mobile app displays these predictions, providing real-time notifications about changes in arrival times or disruptions. By effectively integrating these components, the system empowers users to make informed decisions and optimize their travel plans, ultimately enhancing the overall public transportation experience [7].

A. BLOCK DIAGRAM

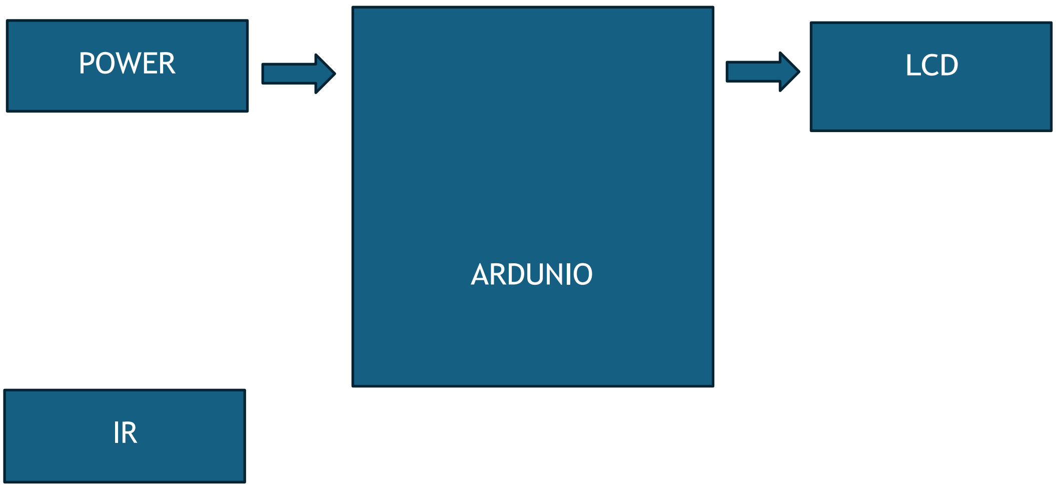

Fig 1: Block diagram of Predicting bus arrival time with mobile phone

ARDUINO

The Arduino is a family of microcontroller boards to simplify electronic design, prototyping and experimenting for artists, hackers, hobbyists, but also many professionals. People use it as brains for their robots, to build new digital music instruments, or to build a system that lets

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your house plants tweet you when they're dry. Arduinos (we use the standard Arduino Uno) are built around an AT mega micro controller — essentially a complete computer with CPU, RAM, Flash memory, and input/output pins, all on a single chip. Unlike, say, a Raspberry Pi, it's designed to attach all kinds of sensors, LEDs, small motors and speakers, servos, etc. directly to these pins, which can read in or output digital or analog voltages between 0 and 5 volts. The Arduino connects to your computer via USB, where you program it in a simple language (C/C++, similar to Java) from inside the free Arduino IDE by uploading your compiled code to the board. Once programmed, the Arduino can run with the USB link back to your computer, or stand-alone without it — no keyboard or screen needed, just power.

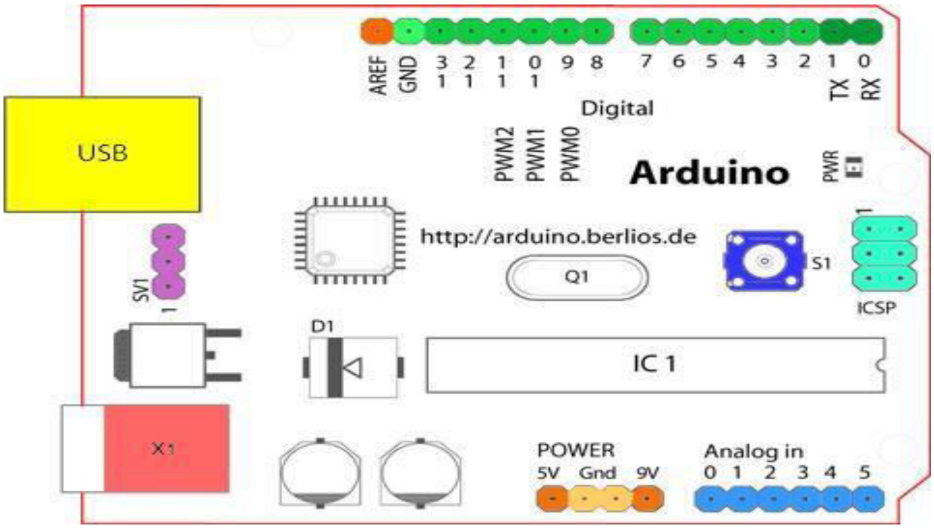

Fig 2: Structure of Arduino Board

B. LCD (Liquid Cristal Display)

A liquid crystal display (LCD) is a thin, flat display device made up of any number of color or monochrome pixels arrayed in front of a light source or reflector. Each pixel consists of a column of liquid crystal molecules suspended between two transparent electrodes, and two polarizing filters, the axes of polarity of which are perpendicular to each other. Without the liquid crystals between them, light passing through one would be blocked by the other. The liquid crystal twists the polarization of light entering one filter to allow it to pass other.

C. LED (Light Emitting Diode)

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. Introduced as a practical electronic component in 1962, early LEDs emitted low-intensity red light, but modern versions are available across the visible, ultraviolet and infrared wavelengths, with very high brightness. The internal structure and parts of a led are shown below.

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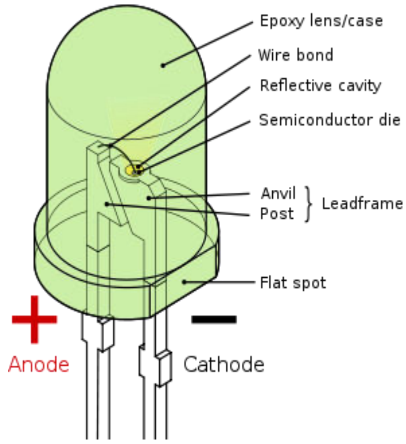

Fig 3: LED

D. SOFTWARE DESCRIPTION

The Arduino is a family of microcontroller boards to simplify electronic design, prototyping and experimenting for artists, hackers, hobbyists, but also many professionals. People use it as brains for their robots, to build new digital music instruments, or to build a system that lets your house plants tweet you when they're dry.

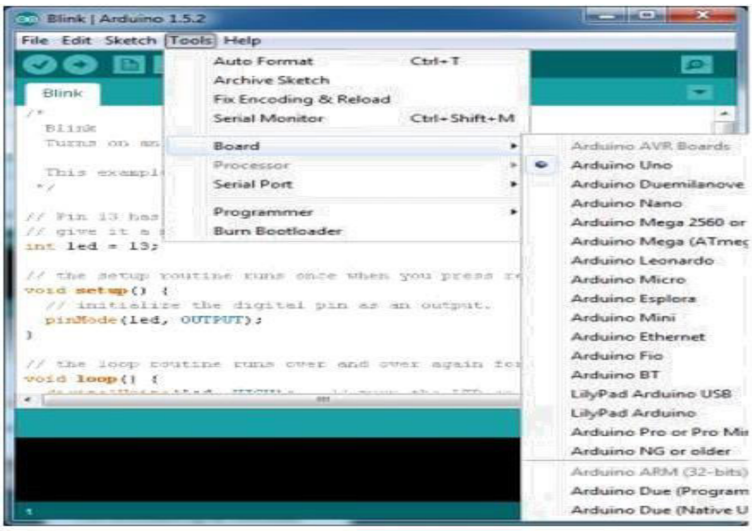

Fig 4: Arduino Software input/output

Arduinos (we use the standard Arduino Uno) are built around an ATmega microcontroller — essentially a complete computer with CPU, RAM, Flash memory, and input/output.

IV. RESULT

Predicting bus arrival times using mobile phone technology offers a promising solution to the challenges of public transportation. By leveraging GPS data from buses, real-time traffic information, and historical data, machine learning models can accurately predict arrival times. These models can be trained on historical data to learn patterns and trends, and then applied to real-time data to generate accurate predictions. The integration of these technologies into

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mobile apps empowers users with real-time information, reducing wait times and improving overall passenger satisfaction. While real-world implementations have demonstrated the potential of this approach, further research and development are needed to address challenges such as data quality, model complexity, and scalability.

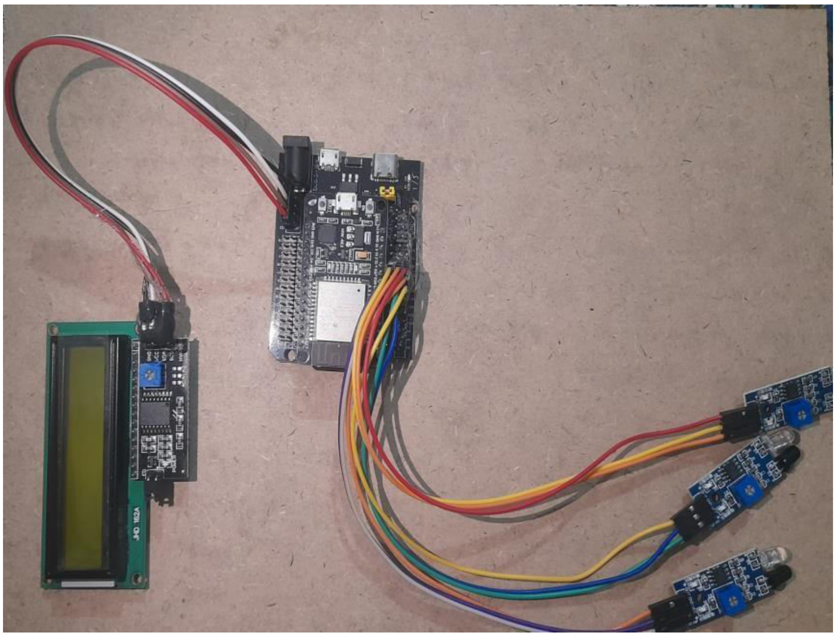

Fig 5: Circuit Schematic for Predicting Bus Arrival

V. CONCLUSION

In this paper, we present a crowd-participated bus arrival time prediction system using commodity mobile phones. Our system efficiently utilizes lightweight onboard sensors which encourages and attracts participatory users. Primarily relying on inexpensive and widely available cellular signals, the proposed system provides cost-efficient solutions to the problem. We comprehensively evaluate the system through a prototype system deployed on the Android platform with two types of mobile phones. Over a 7-week experiment period, the evaluation results demonstrate that our system can accurately predict the bus arrival time. Being independent of any support from transit agencies and location services, the proposed scheme provides a flexible framework for participatory contribution of the community.

REFERENCES

1. K. Radhakrishna, D. Satyaraj, H. Kantari, V. Srividhya, R. Tharun and S. Srinivasan, "Neural Touch for Enhanced Wearable Haptics with Recurrent Neural Network and IoT-Enabled Tactile Experiences," *2024 3rd International Conference for Innovation in Technology (INOCON)*, Bangalore, India, 2024, pp. 1-6,
2. Karne, R. K., & Sreeja, T. K. (2023, November). Cluster based vanet communication for reliable data transmission. In *AIP Conference Proceedings* (Vol. 2587, No. 1). AIP Publishing.
3. Karne, R., & Sreeja, T. K. (2023). Clustering algorithms and comparisons in vehicular ad hoc networks. *Mesopotamian Journal of Computer Science*, *2023*, 115-

123.

4. Karne, R. K., & Sreeja, T. K. (2023). PMLC-Predictions of Mobility and Transmission in a Lane-Based Cluster VANET Validated on Machine Learning. *International Journal on Recent and Innovation Trends in Computing and Communication*, *11*, 477-483.
5. Mohandas, R., Sivapriya, N., Rao, A. S., Radhakrishna, K., & Sahaai, M. B. (2023, February). Development of machine learning framework for the protection of IoT devices. In *2023 7th International Conference on Computing Methodologies and Communication (ICCMC)* (pp. 1394-1398). IEEE.
6. Kumar, A. A., & Karne, R. K. (2022). IIoT-IDS network using inception CNN model. *Journal of Trends in Computer Science and Smart Technology*, *4*(3), 126-138.
7. Karne, R., & Sreeja, T. K. (2022). Routing protocols in vehicular adhoc networks (VANETs). *International Journal of Early Childhood*, *14*(03), 2022.
8. Karne, R. K., & Sreeja, T. K. (2022). A Novel Approach for Dynamic Stable Clustering in VANET Using Deep Learning (LSTM) Model. *IJEER*, *10*(4), 1092-1098.
9. RadhaKrishna Karne, D. T. (2021). COINV-Chances and Obstacles Interpretation to Carry new approaches in the VANET Communications. *Design Engineering*, 10346-10361.
10. RadhaKrishna Karne, D. T. (2021). Review on vanet architecture and applications. *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, *12*(4), 1745-1749.