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# Simulation of a Real-Time Bus Arrival Predictor using RFID and LabVIEW

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# Simulation of a Real-Time Bus Arrival Predictor using RFID and LabVIEW


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***Abstract – Most college and office goers in India use the public buses for daily commuting. The bus network caters to the need of thousands who find it an affordable means of transport. However, the absence of real-time updates in the system poses some very serious problems during the exit period. Large cohorts leave the workplace at one time, leading to over-crowding, chaos and accidents at local bus stops. To address this issue, we have designed an RFID based system that alerts the commuter at periodic intervals as his desired bus approaches the stop. This paper documents the preliminaries, concept validation stage, and the development of a scaled-down prototype. The objective is to notify commuters of the approach of their desired bus (on request) by SMS.***



***Keywords – AT, RFID, public bus, timing predictor, LED, GPS, UHF, Gen2, LabVIEW, VI, RS232, SMS, GSM, POC, ASCII, URI***


## I. INTRODUCTION

Though largely favored, all public bus systems in India (and other developing nations) lack one important feature – providing real-time updates to the commuter regarding location and forecasted time of arrival. No commuter knows where his bus is at a given time, and as a result cannot predict when the bus is going to arrive at the stop. At the end of work hours every day, large multitudes throng the local bus-stop, forced to wait indefinitely. There are certain buses that ply at very low frequencies, and inevitably results in lengthy waiting times for many. When the bus does arrive, there is an unprecedented rush.

In a nutshell, returning from one's workplace/college by public buses is a hassled activity. Being confronted with this problem ourselves on a daily basis, we have designed and prototyped an RFID-based system that that predicts bus arrivals at the local stop. The commuter has to send his preferred destination by SMS, and the real-time location of relevant buses approaching the stop is sent to the commuter. Also, an LED display at the local bus stop will display real-time information (route, destination etc.) about all approaching buses, within a radius of 6km.

Such a system needs a central server to record and sort updates, and distribute them as per request. Code complexity is high, and that is the reason for choosing LabVIEW. Coding in LabVIEW is intuitive, and the server program can be generated much quicker and more efficiently than writing conventional code. Also, interfacing RFID and GSM modules to the server is simplified.

The server for each local stop is to be installed in the place of work, so that it can be monitored and updated by its personnel.

## II. BLOCK DIAGRAM AND PROPOSED DESIGN

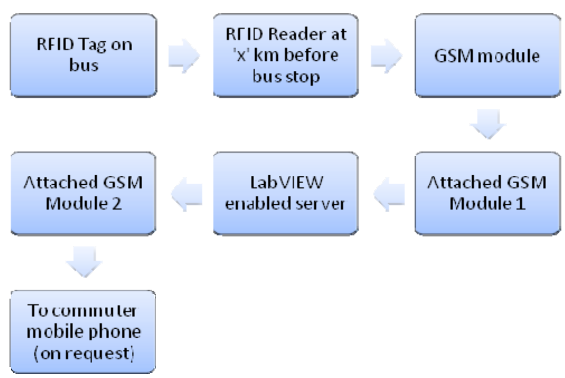


Fig 1. Block Diagram

Since the architecture is modular, i.e., catering to small areas at a time, an event triggered system works better than GPS. Also, it is critical to minimize costs, and GPS systems are inherently expensive. In this system, we sense the arrival of buses at periodic intervals as they approach the bus stop. This paradigm requires installation of sensing hardware at specific points before the local stop, and a unique id for each bus. RFID is the natural choice.Mounted on each bus is an RFID tag. Each of these tags holds a unique 24-bit ASCII code. For simulation and PoC we are using low range passive tags – 125 kHz operational frequency, 5cm range. We have tried to keep the expenditure down to a minimum at this stage. In the full-scale prototype, we will be using Gen-2 RFID tags (active) operating at 900 MHz.

Installed on the road, at distances of 6km, 4km and 3km on either side before the local bus stop are RFID readers. Once again, we have used low-range equipment for concept validation, which is to be replaced by Gen2 protocol based RFID while implementing in full scale. The reader returns the raw ASCII representation of this code. The value is decoded programmatically and formatted to yield the Uniform Resource Identifier (URI). This value is sent to an interfaced PIC Microcontroller (P16F877).

The microcontroller uses suitable AT Commands and sends these values serially to a GSM module. These are now sent via the GSM network across to the GSM modem attached to a LabVIEW enabled computer. The incoming code/id is read, time-stamped, and sorted by route and subscriber by the shown LabVIEW routines. Relevant data is sent to the users via a second GSM module attached to the LabVIEW workstation. Each update on the route shows up on a VI running on a local computer (shown in black in Fig. 3). The display can be extended to an LED display installed at the local stop. We have taken our own institution (RVCE) as the case, and developed solutions for the buses plying past the local bus stop.

## III. Case In Point

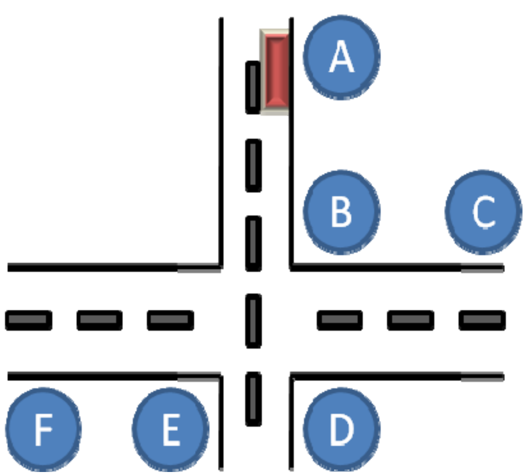


Fig 2. Illustration of the concept

Above shown is the schematic layout of the bus routes in conjunction with our institution. Stop A refers to the local bus stop, and buses ply on either of routes ABC, ABD and AEF. The server assigns the tag ids to respective buses, and responds appropriately to commuter requests. In our scaled – down prototype, we assume that passengers at Stop A need to go to 3 major destinations – BSK, KRM and MAJ.

## IV. LabVIEW Modeling

The aim of the VI is to

1. Capture the input data and match it to a particular bus number
2. Display the bus number along with source, destination and its estimated time of arrival in the VI
3. Respond suitably to requests

The programs will be described by the flow as outlined above.

1. Capture the input data and match it to a particular bus number.

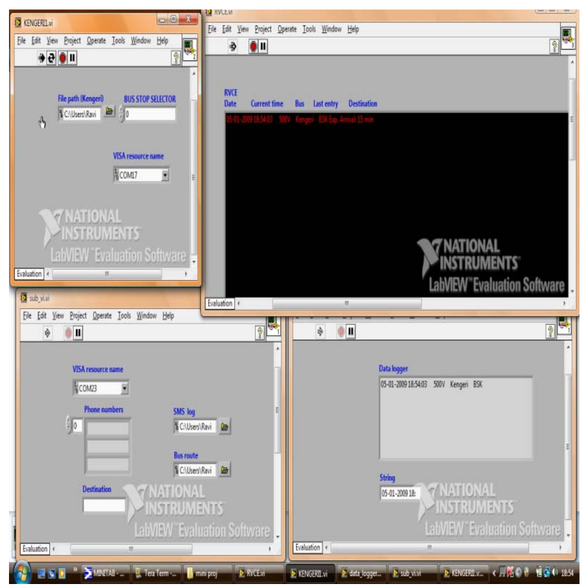

Fig 3. Front Panels of the simulation

The above figure shows the front panels of the VIs used for the implementation.

Fig. 4 is a magnified part showing the output of the software display from Fig. 3.


Fig 4.

Fig. 5 VI is used to perform the initial task of capturing the input data and matching it to a bus number. Its block diagram is shown below.

The VISA Configure serial port is used to acquire the data from the serial port. For this, parameters such as baud rate, VISA resource name, data bits, parity, termination character, stop bits and flow control have to be set. This initializes the serial connection with the computer.

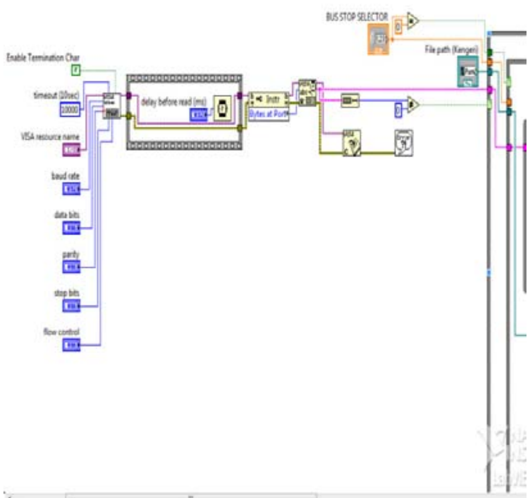


Fig 5.

The output of the VISA configure serial port is wired to a property node to read the bytes at port and the Tag data is obtained. This tag number is checked to obtain the bus number using a while loop which constantly checks the input tag number versus the designated tag numbers for the various buses. This is shown in Fig. 6. Thus the tag number [280070B71EF1] will correspond to [500A Kengeri BSK] which basically signifies [BusNumber Source Destination].

2. Display the bus number along with source, destination and its estimated time of arrival in the VI.

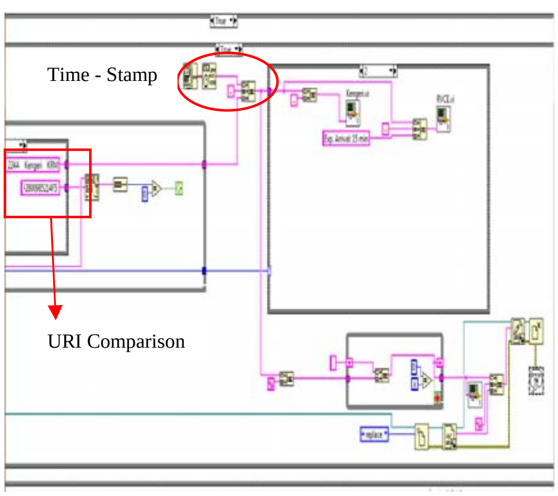


Fig 6.

The output data of [BusNumber Source Destination] is time-stamped and is passed onto the subsequent bus stop for display (Fig. 6). In our case, this is RVCE and hence the RVCE.VI displays the information on the RVCE bus-stop screen.

3. Respond suitably to requests

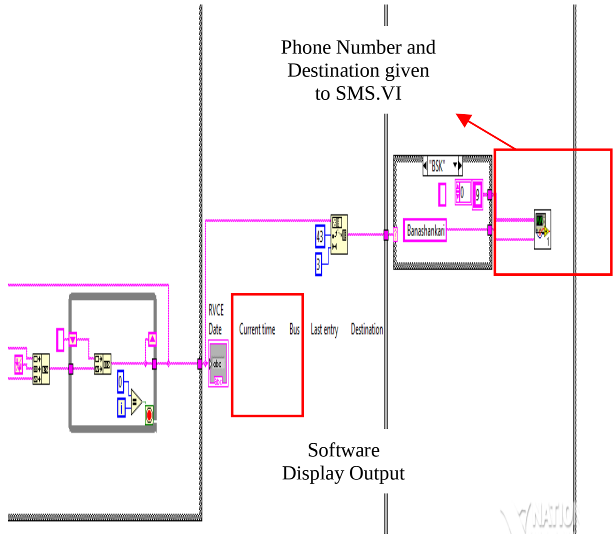


Fig 7. Block Diagram of RVCE.VI (College stop)

The information that is displayed at the RVCE bus terminal must respond to users via an SMS. To accomplish this, we pass on the relevant user's phone number and destination to a SubVI which performs the SMS operation. As seen above, the phone number of the passenger travelling to BSK is passed on to the SMS.VI. The information passed to the SMS.VI will depend on the destination for which the passenger has requested for (here BSK/MAJ/KRM).

The SMS.VI is shown below.

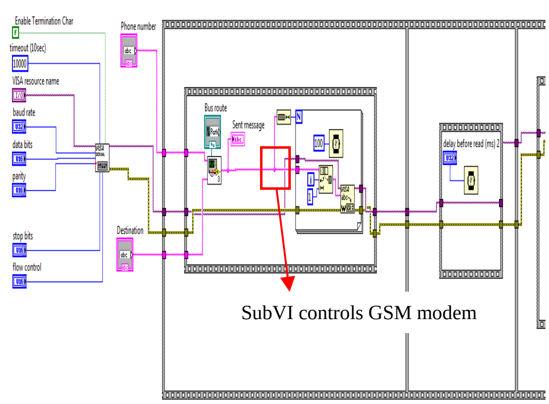

Fig 8. Block Diagram of SMS.VI

The GSM SIM300 module is connected to another serial port of the computer and hence the initialization of the VISA Configure serial port is required. The inputs are the phone number and the destination of the user. This destination is compared to a lookup table and the required text of the SMS is generated. To send an SMS using a GSM modem, it must support the extended set of AT commands.
The commands used are :

AT+CMGF=1 (Setting the modem in the SMS mode)

AT+CMGS=”SUBSCRIBER NUMBER”(Command to send an SMS)
Fig. 9 completes the SMS.VI

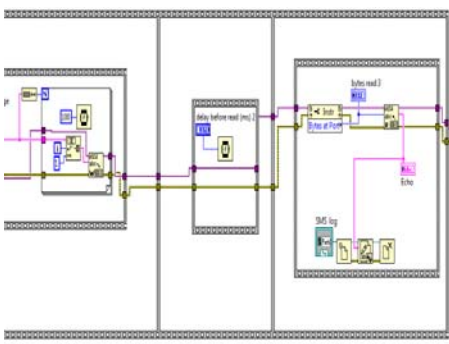

Fig 9. Block Diagram of SMS.VI

The SMS.VI houses a SubVI that is used to control the GSM modem by the use of AT commands. The block diagram is shown below.

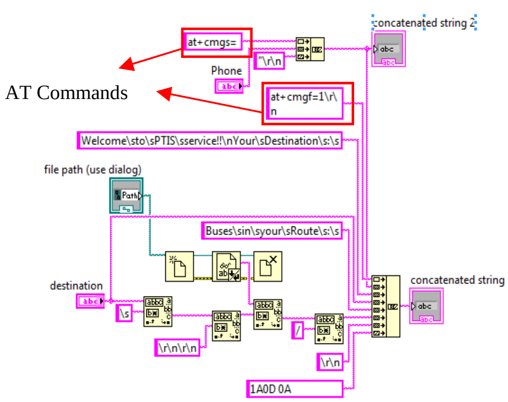


Fig 10. Block Diagram of SubVI (from SMS.vi)

## V. RESULTS

Installing an RFID tag in a bus enables its identity to be apprehended at multiple points before the bus stop using RFID readers. This serves as an effective way of tracking the bus at discrete points before it arrives to the local stop. GSM protocol to exchange data was found to be slightly slow, and may not suit the purpose when large volumes of buses and requests are involved. GPRS can be used as an alternative protocol at the interface between RFID reader and workstation. The overall time lapse between bus detection and SMS alert took up 25 seconds. The LabVIEW program not only sorts out and matches requests and updates, but also provides an ergonomic user interface. All the objectives for concept validation have been achieved.

Fig 11. Table-top working prototype

## VI. CONCLUSIONS

Usage of RFID is an effective way to implement a bus-arrival predictor. It is considerably cheaper than conventional GPS systems, and is very modular in terms of expansion. The next step is to use long-range RFID (Gen-2: 900Mhz.) and implement a full-scale model. Live VI’s running at various locations is a good way of distributing information within campus. Color coding in LCD module is an ergonomic way of describing proximity of buses. A strong business model can take this initiative from concept to product.

## VII. ACKNOWLEDGEMENTS

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## VIII. REFERENCES


[1] Hasan Zoghi, Morteza Tolouei, Kianoush Siamardi, Pegah Araghi: Usage of ITS in the In-vehicle Signing System With RFID tags and Vehicle Routing and Road Traffic Simulation- Proceedings of the 11th International IEEE Conference on Intelligent Transport Systems, Beijing, China, October 12-15, 2008

[2] L. Reichardt, G. Adamiuk, G. Jereczek, and T. Zwick: Car-to-Infrastructure Communication Using Chip-Less, Passive RFID Tags

[3] Hideo Oda, Soichi Kubota, and Yoshiharu Okamoto: Research on Technology for Redcing sudden pedestrian or Cyclist Accidents with vehicles- Proceedings of the 2007 IEEE Intelligent Transportation Systems Conference Seattle, WA, USA, Sept. 30 - Oct. 3, 2007

[4] Yu Cai and Richard C. Liu, *Senior Member*, *IEEE*: Application of RF Tags in Highway Reference Markers- Proceedings of the 11th International IEEE Conference on Intelligent Transportation Systems - Beijing, China, October 12-15, 2008

[5] Hiroaki Togashi, Shigeki Yamada: Preliminary study on vehicle-to-roadside system using RFIDs for detecting road shoulders – IEEE 2009 Pages 1149-1154

[6] Luca Roselli , Valeria Palazzari, Federico Alimenti, and Paolo Mezzanotte: A Ku-band RFID System for Robust Road-to-Car Communications- IEEE 2009 pages 1693 – 1696

[7] Klaus Finkenzeller – RFID handbook - Fundamentals and Applications in Contactless Smart cards and Identification – 2nd Edition, John Wiley and sons.

[8] Jerry Banks, David Hanny, Manuel Panchano, Les G. Thompson – RFID Applied – 2007, John Wiley and sons.

[9] Bill Glover and Himanshu Bhatt, *RFID Essentials*, O'Reilly, 2006.

[10] Daniel Dobkin, *The RF in RFID*, Newnes, 2008.

[11] Jerry Banks, David Hanny, Manuel A. Pachano, Les G. Thompson, *RFID Applied*, John Wiley & Sons, 2007.