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A Real Time Application of Active RFIDs in Multicar Environment for Road Safety

Hakan Koyuncu[1]
[1]Computer Science Department, Loughborough University, Loughborough, UK
[1]*cohk@lboro.ac.uk*
Baki Koyuncu[2]
[2]Computer Engineering department, Ankara University, Ankara, Turkey
[2]*bkoyuncu@ankara.edu.tr*

Abstract: *Radio Frequency Identification Devices (RFID) were studied to use in broadcasting the speed limit information for the drivers. Software was developed for active tags to transmit the speed limit information outside their stack forming networks. Active readers, mounted in the cars, received this speed limit information in real time with the help of the developed software. JENNIC wireless sensor nodes were programmed to be used as active RFIDs in this study.*

Keywords: *active tags/readers, passive tags/ readers, Zig Bee Home sensor, Site survey tool*

1. INTRODUCTION

RFIDs have a long history since world war two [1]. They use radio waves to identify and track the objects. An RFID system consists of tags and readers.

Tags are electronic labels which contain identification codes such as product information. This information is transmitted at the right time to be received by the readers. There are two types of RFID tags. Passive tags with no self-energy source and active tags with an onboard energy source.

Incoming radio signals charge an onboard capacitor and this charge in return provides the transmission energy for the passive tags. The active tags, on the contrary, receive their energy from onboard battery for transmission or reception purposes.

RFIDs are used in the applications of logistics, tracking, manufacturing, healthcare, personnel identification and payment systems. In this study active RFIDs were used to display the speed limit information in different traffic zones in real time.

If the drivers know their speeds with respect to the speed limits, then they can adjust their speeds. Road signs, used at present, are not practical due to the fact that the drivers may not see them because of bad weather, obstacles or night time conditions. Hence the drivers must be assisted on the roads to receive speed limit information while sitting in the comfort of their cars.

2. ACTIVE TAG READER PAIR

JENNIC JN-AN–1052 "Home Sensor Demons- tration Kit "using Zigbee standards was employed in this study [2]. ZigBee is a low cost, low power wireless mesh networking standards used with JENNIC devices.

ZigBee Home Sensor demonstration kit contains identical general purpose RFIDs. They are programmed by using ZigBee software to act as tags or readers. The active tag used in this study is shown in Figure 1.

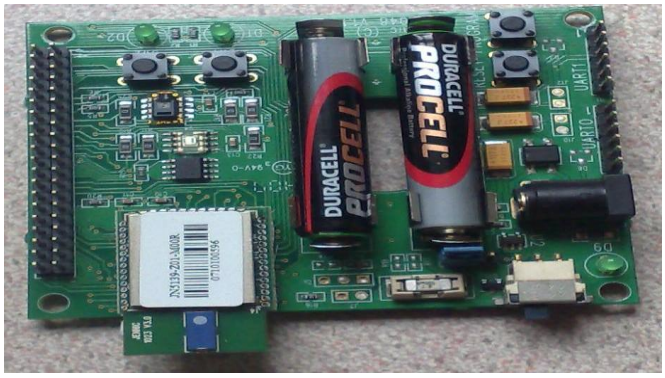


Fig1. *JENNIC Active RFID tag*

Active tag has a sensor board to measure the temperature, humidity and light levels. Sensor board periodically sends these measurements to controller board on the reader. Active RFID reader has a controller board with LCD panel. See **Figure 2**. Controller board displays the received data on its built-in LCD panel. Controller board, sensor board and the three sensors act as Coordinator, Router and end devices respectively.

Bin files **[3]** of the compiled ZigBee software for the reader and the tag are given as:

HomeSensorCoord.bin for the reader

HomeSensorEndDevice.bin for the tag

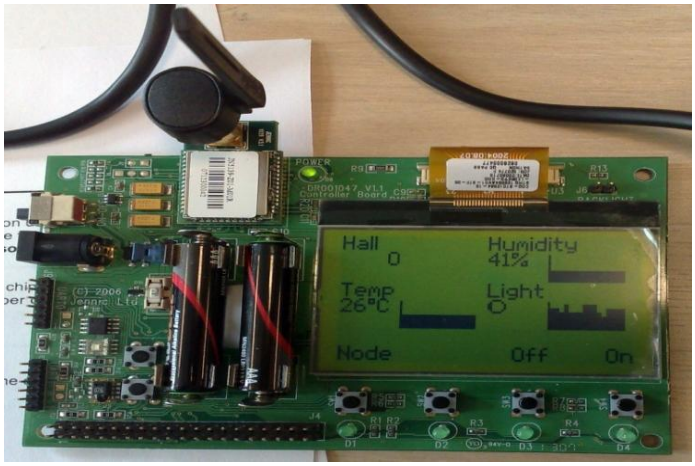


Fig2. *JENNIC Active RFID Reader with 3 sensor parameters displayed*

JENNIC devices are initially interfaced to a host Computer through a USB port. They are programmed to be an active tag and an active reader by placing the respective BIN files into their onboard memories.

During these enabling processes active reader allows an RF communication channel to be selected. Once this channel is selected, communication protocol with the active tag will be set and the communication will be established to transfer data from the active tag to the active reader.

Sensor data is periodically updated in real time on the LCD display panel of the active reader. After initial downloading of the "JN-AN–1052-ZigBee-Home-Sensor-Demo" program into the host computer and uploading the BIN files into the active devices; the reader LCD display panel shows the sensor readings transmitted from the tag. Once this communication channel is set between a tag and a reader; another close by reader cannot receive the same information in real time.

3. SINGLE TAG MULTIPLE READERS

ZigBee software is programmed by JENNIC for multiple tag transmissions and a single reader reception at any given time. But a single tag transmission is not received by multiple readers. ZigBee software uses a stack forming network. Once a tag transmission is received by a reader, this tag joins the reader's Zigbee network and it is not able to join any other reader network. This results a disconnection in transmission between the tag and the other readers. Consequently the LCD panels of the other readers display "No tag detected "messages.

In practice, every car needs to receive speed limit information and hence it is installed with a reader. The ZigBee software will not allow multiple readers (cars) to read the transmitted speed limit information from a single tag at the same time.

This problem was solved, in this study, by modifying the software from the same JENNIC program library [4], called "JN-AN-1014 Checking for channel activity using the Site Survey Tool". This program is a Production test Application program and it is substantially modified compared to previous ZigBee software.

The modified program is structured to eliminate the Zigbee stack formation and the IEEE 802 standard for networking. It provides simple real time information detection for the multiple readers coming from a single transmitter tag.

Initially, readers display "No tag detected" text message when there is no reception from a single tag, See **Figure 3.** Numerical speed information is displayed on the readers when there is reception from a single tag on the road.

Fig3. *LCD panels of two Readers displaying "No tag detected" message. (Readers are ON,Tag is OFF)*

Different functions such as "vJPT_PacketTx()" and "bJPT_PacketRx()" are introduced in the modified programs [5]. "vJPT_PacketTx()" is used to create a transmission channel and to send the object packages. "bJPT_PacketRx()" is used to receive the radio frequency transmission on the reader side. They create, together, a transmission / reception channel between the tag and the reader and cause the information packages to be sent between them.

New algorithms are developed for the reader and the tag programming. Source program "JN-AN-1014 Checking for channel activity using the Site Survey Tool" is modified for real time communication in multi reader environment. The newly developed programs are stored in tag and reader onboard memories to operate them in real time environment [5].

Modified tag and reader programs help many active readers , representing multiple number of cars on the road , to detect a single tag transmission and to display its speed limit information on their LCD panels. An example speed limit reception from 2 readers at the same time are displayed in Figure 4.

Fig4. *LCD panels of two Readers displaying speed limit information.*

4. EXPERIMENTATION

Once the "Home Sensor Demo" source program is modified for the multiple tags /single reader case, Multiple active tags are programmed for different speed limits and tested with a reader. This simulated the different traffic zones far from each other with different speed limits along the road.

When the car enters these different traffic zones, the onboard reader would receive the particular broadcast from a particular tag and display it on its LCD display panel.

The experiment was carried out with 3 active tags. Imaginary Speed limits were chosen as 10 mph, 50mph and 100 mph. Tag1 was programmed to contain 10 mph, Tag2 was programmed to contain 50 mph and Tag3 was programmed to contain 100 mph speed limits in their on board memories. A block diagram was given in Figure 5.

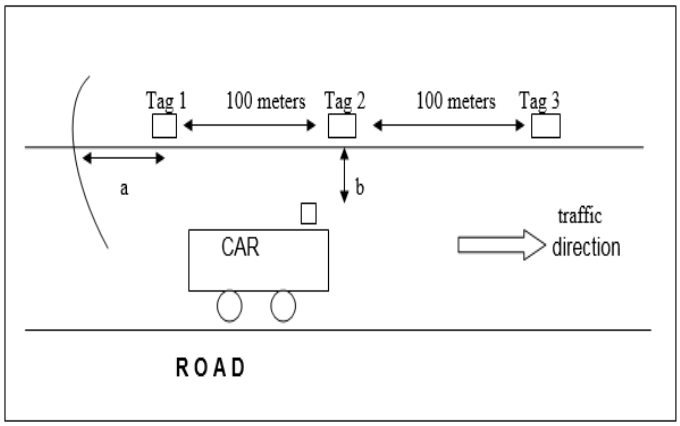


Fig5. *Block diagram for the tag/ reader combination on the road (a=70 steps, b= 7steps)*

These tags were placed on the side of the road on garden walls with a height of around 1meter. Their transmitting aerials were facing the road and the cars. The road was chosen to be a straight road without curvatures and the tags were placed with 100 meters between them as shown in block diagram in **Figure 5**.

The experimental car travelled along the road and it was observed that the speed limits stored in tags were detected by the reader in the car. The experimental car travelled in a busy day time traffic at 3 different speeds such as 10mph, 50mph and 100mph. At each car speed the stored speed limits in the tags were detected as the car passed in front of the respected tag. Hence the aerial reception from the reader was not effected by the higher car speeds.

It is observed that the transmissions from the tags are in spherical form. There is a circular perimeter where the tag transmission is detected by the reader. As the car approaches to a tag, the stored speed limit in the tag is detected by the reader at a radius of "a" to the reader as shown in Figure 5.. Once the car passed the tag, the detection by the reader seizes to exist at "a" distance and the reader showed disconnected. When the car approaches the next tag the same situation is repeated. when the experiments are repeated carefully, "a" detection range is found to be 70 steps which was the general detection range with these reader/tag combinations.

5. SOFTWARE DEVELOPMENT FOR EXCESS SPEED DISPLAY

The drivers usually want to know his/her excess speed over the speed limit during driving. To display the excess speed on the LCD panel of the reader, the current Home sensor demo software is modified and stored in the vehicle reader. The modified software receives the vehicle speed data from its speedometer and the speed limit data arriving from the tag transmission as inputs. It calculates the speed difference between the two input speeds and displays this difference on the LCD panel.

Vehicle speed data arrives at reader in a digital 8 bit code corresponding to the calibrared voltage proportional to the speed of the car, The way this was done is outside the scope of this study. This digital 8 bit code is later converted to a decimal number by the reader to be displayed on its LCD panel in real time. As the speed of the vehicle changes, the car speed information on the LCD panel also changes.

For example, if the vehicle is going 60 mph and the speed limit in that traffic zone is 60 mph. Then the vehicle is within the speed limits. The LCD panel displayes the following texts:

"Your speed is 60 mph" .

"The speed limit in the traffic zone is 60 mph"

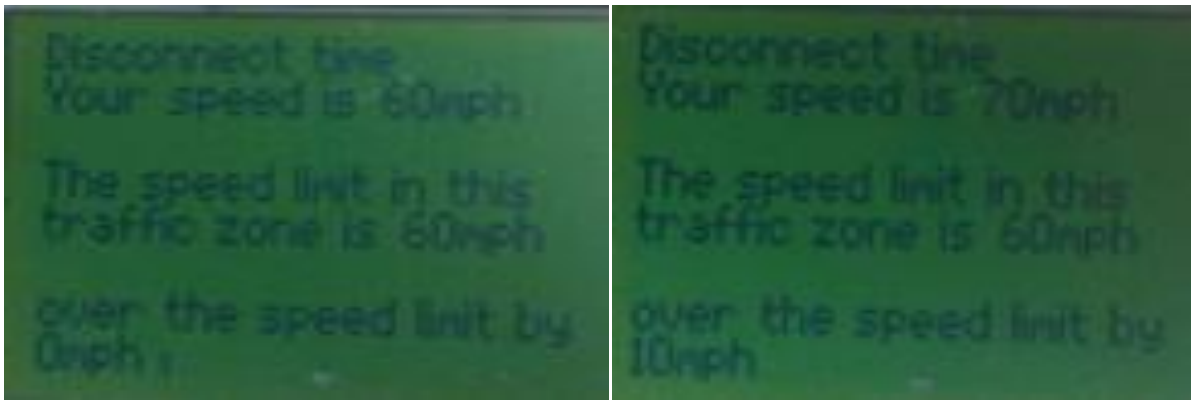
"over the speed limit by 0mph".

The new software calculates the speed difference and displays it in a text message as seen in Figure 6a.

When the vehicle speed increases to 70mph, the excess speed is displayed as an additional text form of "over the speed limit by 10mph." . See Figure 6b. This warning message will hopefully help the user to slow down and obey the traffic rules .

6. CONCLUSIONS

Overall aim of this study was to adopt the active tag and the readers for multicar traffic environment on the roads. JENNIC devices were reprogrammed first time to transmit and receive in real time without any stack and ZigBee network limitations.



(a) **(b)**

Fig6. *a) vehicle speed of 60mph, b) vehicle speed of 70mph while speed limit is 60mph*

This new software development allowed the usage of readers and tags outside the ZigBee network. Active tags are placed strategically along the roads without interfering in each others' transmissions. The readers on the cars would receive the tag transmissions freely in real time when they enter the tag transmission zones.

In urban traffic, due to the congestion of the roads and the closeness of the tags to each other on these roads, transmission zones of the tags would interfere with each other and the receptions from the vehicle readers would deteriorate substantially. This is identified in the literature as the tag collision. This will be studied in the next phase of the study.

REFERENCES

[1] http://en.wikipedia.org/wiki/Radio-Frequency_ identification
[2] http://www.jennic.com/jennic_support/application_notes/jn-an052_home_sensor_demonstration_ using zigbee
[3] http://www.jennic.com/files/support_ documentation/JN-AN-1052-ZigBee-Home-Sensor-Demo-1v3.pdf
[4] http://www.jennic.com/files/support_ documentation/JN-AN-1014-Site-Survey-Tool-2v4.pdf
[5] A study of passive and active RFID systems for speed control in rural and urban traffic, Hakan Koyuncu MSC Thesis ,Computer Science department, Loughborough University, September 2009

AUTHORS' BIOGRAPHY

Baki Koyuncu, is a professor in computer eng dept of Ankara university. He has received his BSc, Msc and PHD from Birmingham and Loughborough universities in united Kingdom . He is an IEEE senior member. He teaches computer hardware and software courses. His research areas are image processing , computer hardware , embedded systems , wireless sensor networks and RFIDs.

Hakan Koyuncu, is in computer science department of Loughborough University, UK. He has currently finished his PhD research in the area of RFIDs and position detection of objects in indoors. His research interests include wireless sensors, wireless networks and mobile Communication. He has completed his MSC in multimedia and wireless networks. He has developed algorithms to determine the accurate positions of the mobile and stationary objects.