A Cost Effective Automatic Online Bus Information System using RFID and ZigBee

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Abstract— **Nowadays, transportation plays a very important role for students in the day to day life of the educational institutions, these institutes are mostly located out of cities. Need of monitoring the travel time and driver information are the major components of traveller information system in the institutions. The travel time of buses varies depending on some parameters such as Bus Drivers doesn't follow time schedules, negligence and beyond the speed limits. Monitoring the bus travel time information can give many advantages such as reducing accidents leaded by over speed, time delay, and miscellaneous activities of drivers.**
In this paper, a cost effective idea is proposed, i.e., integration of Radio Frequency Identification (RFID) with Zigbee. When compared with existing RFID and other technologies, the proposed system gives more reliable, cost effective and fast means of long distance objects identification.

Keywords— **RFID, Zigbee, Driver, ATIS, Database, and Bus.**

I. INTRODUCTION

As the world enters the 21st century, the quality of education continues to be a major factor in a nation's ability to succeed and excel. Travel time information becomes a major component of Advanced Traveller Information System (ATIS) [2]. Transportation facilities is essential for students in educational institutions because many of the educational institutions are out of city. Due to this many college/schools bus drivers not following time schedule. As the time is said to be eternal, logging the timings of the transport means like a bus is essential in all educational institutions. Especially in educational institutions both driver information and bus information is logged by the gate keeper and maintains manual reports. This manual process may not accurate to monitor the bus and driver information for right arrival times of the buses in the campuses of educational institutes. This generates many disadvantages like :
1. Wrongly recorded travel **in and out** timings may happen in the manual entry processes.
2. Difficult to identify which driver driving in which bus when the institute having large number of buses.
3. Miscellaneous driver activities may leaded by over speed, time delay and other activities.
There is a need of monitoring the travel time and driver information. So that, in this paper a cost effective idea is proposed by integration of Radio Frequency Identification (RFID) with Zigbee. There are many RFID and other related technologies giving solutions to above mentioned problems, they are mainly having the following drawbacks:

1. Very high cost- using RFID the read range is increases from antenna to tag, increases cost.
2. These technologies may not accurate and reliable.
3. Small and Middle range managements of educational institutes may not show interest in using costly technologies.

By keeping the above mentioned drawbacks, a cost effective idea is proposed by integration of Radio Frequency Identification (RFID) with Zigbee. This proposed system employs the wireless communication [3] device Zigbee concept along with RFID technology in a cost effective, long distance object detection and easily deployable manner for this task of logging Bus and Driver information in detail and this can be used anywhere where the transportation need is met with. When the read rage of RFID devices increases, the cost of that device also increases. The Important module of this system is 'in time, out time', and in which bus the driver is recorded daily. Monitoring this information can give many advantages like reducing accidents leaded by over speeding and monitoring driver activities even many more. With technological advancement of the world all the manual works are replaced by automation. In this case now-a-days logging information is also mostly done in tech manner and only in very few cases hand written log books can be seen. There are many advanced technologies are existed for accomplishing this task but as per our knowledge of survey they are costly, less available and hard to deploy in all situations.

Since this time, RFID technology has been evolving to change the way people live and work. Many previous research projects have explored the possibility of integrating RFID in different areas, from toll collection [4], agriculture [5], access control [6], supply chain [7], logistics [8], healthcare [9], and library [10].
We came up with an affordable and simple hand held device powered up by a 12v battery that worked on the basis of ZIGBE, RFID reader and a PC with necessary software. The gate keeper can operate this and the details of both the bus driver and particular bus are recorded in a database in a formal manner, so that one can check and print. Even survey can be done on the logged information by a user understandable graphical user interface and report can be generated.

Processes of proposed System:

Fig. 1 shows the complete processes of proposed system. When the bus arrived at the gate the guard will scan the RFID card of the bus and next he will scan that bus driver's card which is given previously. Then the details of the bus and the driver details will be sent to the database and stored in the form. This can be reviewed by the transport administrator and can be printed/stored in .xls form.
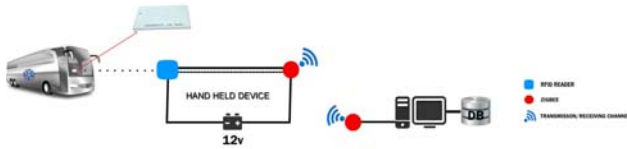

Fig.1. processes diagram of proposed system

Advantages of proposed system over existing systems:

- It very Low cost device compared to other existing technologies for long distance object detection.
- The maintenance of this system is very easy, because there no much hardware and software components.
- This is Controller less device.
- Operated by a simple JAVA / C code
- Data can be monitored through web enabled device with in network.
- Future enhancements can be done easily.
- It can be easily deployed anywhere.
- All economical ranges of educational institutions can afford.

In Section II, related work in RFID applications Zigbee is discussed. The proposed system architectures are introduced in Section III. System implementation and methodology is presented in Section IV. The experimental results are discussed in section V. Finally, a brief conclusion and future work are given in Section VI.

II. RELATED WORK

In this section, RFID applications and smart environment researches are reviewed.

RFID applications there are three major components of an RFID system: the reader, the antenna, and the tags [14]. Each tag is associated with a unique number. When a tag is in the detection range of the reader, the number is read. Two types of tags can be found: active tags with a longer detection range and passive tags with a shorter detection range [14]. An RFID tag is usually attached to an object and the information of the object along with the RFID number are recorded in the database. Whenever the RFID tag is sensed, the object can thus be identified.

The papers to be discussed here are more advanced applications. One of the papers deploys a large amount of RFID tags in an office, a conference venue or other public places. The user can use mobile devices to receive desired information like locations or maps, also the user can leave a message to a certain person. Besides, the maps can be retrieved by the rescue crew in emergency through a tag [15]. RFID was also applied to home cooking. First, RFID tags are attached to ingredients and utensils. The system can automatically provide video instructions to the user according to the detected movements of the user. The user needs not check the cook book step by step [16].

Another paper proposed a client-server architecture that can remotely control home appliances via mobile devices. Massive RFID tags are distributed in the environment for location awareness. The advantages of this system are less power consumption and design complexity [17]. In medical care, there is an RFID application related to medicine taking. RFID tags are attached to medicine bottles and the reader is placed in the drawer storing the medicine. The system can help the elderly people to record their medicine-taking data and determine whether they have taken the right medication with right dosage [18]. On the other hand, the assessment of independent living ability for the elderly can also be done by the RFID technology. RFID tags are attached to the tools used in our daily life. Readers are placed on different body parts of the elder. Home activities of the elder can thus be recorded [19-20]. Above-mentioned researches were keen to use the RFID technology to provide the users with convenient services[21]. Although the RFID tags deployed in the public areas can help reach the goal, the tag price is still too high to make it feasible in real applications. In addition, using RFID to detect user's activities requires the user to carry RFID readers. This is very inconvenient to the user. Hopefully, the RFID reader can become much smaller and light-weighted in the near future.

Ref. [22] presents a novel bus priority control system for the Advanced Public Transportation System (APTS) based on wireless sensor networks and ZigBee. Authors of [23] reported the use of ZigBee RF nodes for data packet transmission in an intra-car wireless environment.

III. PROPOSED SYSTEM ARCHITECTURE

There are two levels of architectures are proposed to develop this system, they are
1. Hardware architecture
2. Web Enable Software architecture
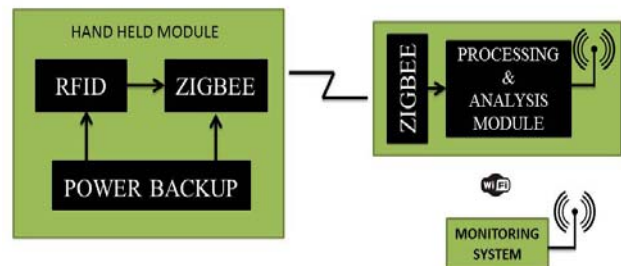
Hardware Architecture:

Fig.2 Proposed Hardware Architecture

RFID Reader: As shown in the fig.2, the process begins when RFID[16] tag comes in the range of the RFID reader then the reader transmits the signals to the tag. Then tag will modulate that carrier signal with the data present in it. Then this modulated signal will be received by the RFID reader. The reader is having the Tx pin directly connected to Rx pin of Zigbee, so the data will be transferred from the transmitter (Tx) pin of reader to the input for the Zigbee.

And also the GND pins are directly connected between them. In this system every bus is equipped with a RFID card near the driver's window, so that it will be easy to the gate guard to scan the RFID card with our hand held scanner (reader). And even for the every driver a RFID card is given, whereas the driver name also have to be in the log. The specification of this module is 125kHZ.

ZIGBEE: ZigBee has been developed to meet the growing demand for capable wireless networking between numerous low power devices. This new level of communication permits finely-tuned remote monitoring and manipulation [24-25]. This is one of the familiar components of wireless sensors based on an IEEE 802.15 standard. ZIGBEE[14] is a specification for wireless personal area networks (WPANs) operating at 868 MHz, 902-928 MHz, and 2.4 GHz. A WPAN is a personal area network (a network for interconnecting an individual's devices) in which the device connections are wireless[18].

Using ZIGBEE, devices in a WPAN can communicate at speeds of up to 250 Kbps while physically separated by distances of up to 50 meters in typical circumstances and greater distances in an ideal environment here we are using two ZIGBEE modules. One acts as receiver and another as a transmitter. Probably the receiver is at the PC and the transmitter will be at the hand held device. Whenever the reader in the device scans the RFID tag of the bus/driver then the details in that card are read by the RFID reader and the transmitter ZIGBEE will send them to the receiver ZIGBEE and then to the PC from there i.e. to the database.

Power Backup: consists of 12v battery charging with 15 v DC adapter The output of this connected to the RFID module and Zigbee module and its charging capacity is 5hrs.

Processing and Analysis Module: It is main system where the program will run and all the recorded details are stored. As this system is connected in the network through Wi-Fi, one can access this from anywhere. The detailed web enabled architecture is shown in fig.3.

Monitoring System: Through Wi-Fi the data can be accessed from processing and analysis module which can be viewed/printed.

Web Enable Software Architecture
The layer wise software architecture show in Fig.3.This system consist of e four layers.
1. Interface layer
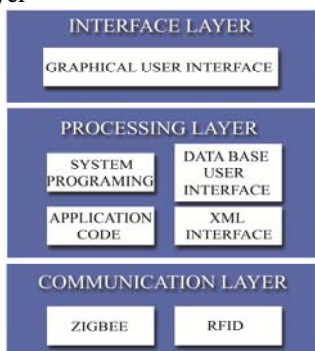2. Middleware layer
3. Communication layer
4. Physical Layer

Fig.3 Web Enabled RFID and ZIGBEE Architecture

Communication Layer: This layer provides Three stages of communication:
1. between rfid and zigbee within hand held device.
2. between zigbee of hand held device and zigbee which connected to processing module.
3. between processing module and monitoring system through Wi-Fi.

Processing Layer: This layer having system programming, database user interface, application code, and XML interface.

System programming: Serial communication patterns are used here. Serial communication is the process of sending data one bit at a time, sequentially, over a communication channel or computer bus. This is in contrast to parallel communication, where several bits are sent as a whole, on a link with several parallel channels. Basically we worked on windows-XP operation system.

Application code: As java is a concurrent, class-based, object-oriented, and specifically designed to have as few implementation dependencies as possible, all our control code is written in java. And database connectivity is established from Oracle server software.

XML Interface: Extensible Mark-up Language (XML) is a mark-up language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. Design goals of XML emphasize simplicity, generality, and usability over the Internet.

Database user interface: A database is an organized collection of data. The data are typically organized to model relevant aspects of reality in a way that supports processes requiring this information. The interface is designed in such a way for example, modelling the availability of rooms in hotels in a way that supports finding a hotel with vacancies. Interface developed in such a way that survey can also be done.

IV. METHODOLOGY

The proposed system working processing methodology for the developed of system is explained in the following algorithm and flow chart.

Algorithm :
Step 1: Data base and other program modules starts with switching on the system.
Step 2: Hand held device is checked for charging and kept ready.
Step 3: When bus arrived at the institue gate , the watch man goes to bus with hand held device   and shows it to driver and bus RFID cards.
Step 4: The hand held device sends this information to processing module.
Step 5: If the RFID card data of the driver and bus are matching with database data, then the   driver   report and bus report tables are updated.
Step 6: Once the driver and bus report tables are updated , then the final report table updated   with fields like bus no., route name, driver name, etc.,.
Step 7: Watch man ready for the next bus and repear the step no.1
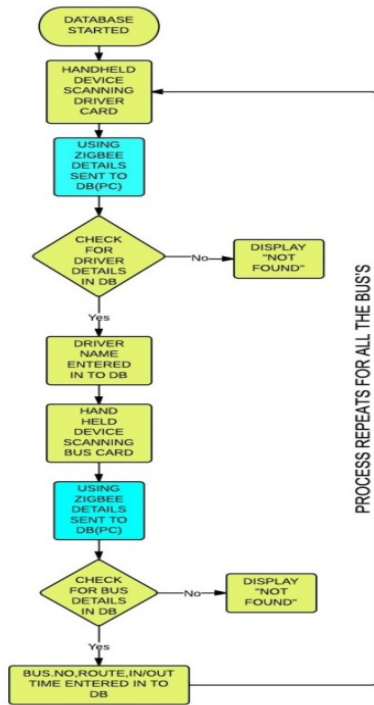
Flow chart :

Fig.4 Flowchart for execution processes of proposed system

V. EXPERMENTAL RESULTS

Development of Hand Held Device:

The detailed pictorial description about the construction of hand held device shown in Fig. 5.

Fig.5. Development Stages

Database Tables:

The enrolled details of driver and bus with their respective RFID TAG numbers are stored in the Oracle data base as shown in the Fig. 6 and Fig. 7.

S_NO	RFID_NO	DRIVER_NAME	MOBILE_NO	YES_NO	JOINING_DATE	D_ID
3	04163139	S S Manyam	9963651974	N	-	D3
4	04163138	M Srinivasa Rao	7794011545	N	-	D4
1	04163141	E Raju	9848626905	N	-	D1
2	04163140	P Raja	9550293427	N	-	D2

Fig. 6 Driver enrolment details.

S_NO	REF_NO	BUS_NO	ROUTENAME	ENROL_DATE	YES_NO	BUS_ID	SEATING_CAPACITY
3	04144250	AP31 TD 7090	Seethammadhara	13/02/2014	Y	B3	60
4	04149531	AP31 TD 7092	Hanumanthawaka	13/02/2014	Y	B4	60
1	04144248	AP07 TW 7161	Jagadamba	13/02/2014	Y	B1	61
5	04151756	AP31 TD 7088	Pendurthi	13/03/2014	Y	B5	60
2	04144249	AP31 TU 9613	Hanumanthawaka	13/03/2014	Y	B2	61

Fig. 7 Bus enrolment details.

Report:

Fig.7 shows the live data displayed at remote PC, called as a monitoring system located at the office room. The report gives an automatic **in and out** timings along with the current driver information, so that there is no need of maintaining hand written logs.
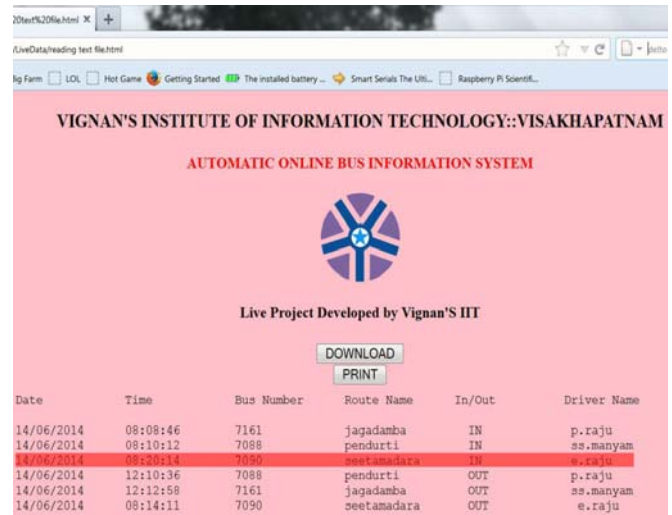

Fig. 8 Driver enrolment details.

The results shown in the above figure indicating that if any bus not arrived in specified time to the campus are automatically visualized in red mark, so that the respective action can be taken by the management on driver.

Results and Discussions:

when compared with existing RFID and other technologies, the proposed idea applied on the developed application called "Automatic Bus And Driver Online Information System" gives more reliable, portable, robust, and cost effective solutions for long distance object identification.

This system deployed and tested with 30 buses and 40 drivers and it is successfully running in our college campus, which is one of the reputed engineering colleges , Vignan's Institute of Information Technology(VIIT), Visakhapatnam.

VI. CONCLUSIONS

The RFID and Zigbee are emergent technologies which are used in wide range of applications. In this paper generated an effective solution called "Automatic Bus and Driver Online Information System " by integrating both RFID and ZigBee. This system has given the reliable and low cost results when compared with other related existing technologies. The design, implementation, and maintenance of this system is very easy because there no much hardware and software complexity. In future the entire system will be automated based on web enabled processor that can give more effective results.

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