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RFID Based Bus Ticketing System

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ABSTRACT:This paper presents an automated system for ticketing in the Public Transport System (PTS) which is based on passenger identification. This is a user friendly system, which will automatically identify the passenger and deduct the passenger's fare according to the distance travelled. The Radio Frequency Identification (RFID) card and GPS are used to make the identification of passenger and transaction very precise. The cards being reusable, they are much more convenient compared to the paper based ticketing system. RFID cards are distributes among the public. The unique ID in the RFID cards are stored in a database in the internet along with personal data and creates accounts for each person. By accessing this database, it is thus possible to identify the traveller, check his account and deduct the fare from his/her account. Creating database facilitates efficient filtering of anti-social elements and gives firm assurance to both passenger and PTS about the transaction. Fare calculation is done with the help of GPS module and internet. So a change in fare does not create any confusion as fare calculation is done by evaluating position by GPS module and rate through internet. System thus reduces human errors and efforts. The RFID reader used is MFRC522. Minicomputer Raspberry Pi is used as control unit and programing is done using Python. GPS module 02 is used for the purpose of distance measuring. Servo motors and LCD are used for controlling and monitoring respectively.

KEYWORDS:RFID, GPS, Raspberry Pi, Python.

I.INTRODUCTION

PTS remains the major source of income in most of the developing countries like India. ButPTS now faces severe malfunction and various security problems. First, there is a lot of confusion between the passengers regarding fares which lead to quarrels and corruption. In addition to this, nowadays there is a severe security crisis in PTS due anti-social elements. The user friendly automated ticketing system suggested in this paper will not only automatically deduct the passenger's fare according to the distance travelled but also detect the passenger's identification. This is possible by use of RFID cards and GPS, and can be used to make the transaction and travelling very precise. This paper basically deals with the identification and ticketing of the passengers travelling by the bus. Also discusses possible future extensions of this system in areas such as Internet–of-Things (IoT).The idea of using RFID in PTS was previously put forward by different personalities [1-6]. But the system proposed here stays closer to a future ticketing system than anything else. Usage of Raspberry Pi is another important feature owing to possibilities of future expansions and alternations. With the advent of new systems to replace Pi, smaller and more reliable systems are expected to come into existence.

RFID has been an emerging technology in recent years. RFID technology can be effectively employed in number of applications due to its penchant for efficiency.As for its application, it's been a widespread tool for both tracking the transit transports. A fundamental system of RFID consists of two primary components: The reader circuit and tag, details of which are discussed later.The usage of RFID has a great advantage as it is considered to be an integral part of IoT. IoT refers to a global network infrastructure, linking physical and virtual objects through exploitation of data capture and communication capabilities [7].Identification of objects is a huge task ahead of IoT and usage of RFID in PTS can be considered a step towards implementing IoT[10].The proposed system mainly acts to bring out the consistency among various bus agencies that will conclude in uniform access of passengers in daily rides through an automated server being updated every single time the passengers travel by carrying the RFID based tickets.

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There were many works previously carried out related to theautomated bus ticketing system using RFID andcase studies has been donerelated toissues in PTS. Some of them are enlisted here. Md.FoisalMahediHasan et.al [1] portrays about the public transport ticketing system, prevailing in the megacity Dhaka (Bangladesh) which introduces severe mal-function in the system, malicious argument among public, corruption and most of all traffic jam. This paper actually suggests a much more public friendly, automatedsystem of ticketing as well as the credit transaction with the use of RFID based tickets.SaurabhChatterjee et.al [6] suggest a user friendly automated traffic control system which will automatically detect a vehicle using the RFID active tag attached tothe vehicle and as soon as the vehicle passes by a reader, this process would lead to identification of each vehicle reducing traffic malfunction and also reducing securityproblems.Varun Krishna K.G et.al [7] primarily suggests the use of RFID technology to provide an efficient and enhanced automated ticketing system. Taking into considerationthe capital and complexity, this paper suggests the implementation of the ticketingsystem by making use of a cyclometer which can be coupled to the wheel(s) of thebus to measure the accurate distance travelled by the user. Butthe use of cyclometer, which is coupled to the wheel(s) of the bus, is both complexand tedious.So here we used GPS system for measuring distance. Applications of RFID technology in IoT are very well discussed byXiaolinJia et al.[10]. Also advantages of using RFID for mob data analysis have been verified by ZalzalaA et al. in [11]. This backs the idea of using RFID technology in PTS.From the paper of Michalak S [13], we get the idea about the use of Raspberry Pi mini-computer instead of PC computer in measurement systems. Also advantages and application of Raspberry Pi mini-computer are discussed in this paper.

After going through these papers, we got the idea to do a project on RFID basedBus Ticketing System. The idea was to create a system capable of mass identificationprocess, precise location data recorder and easier and faster contactless payment.

II.HARDWARE DESCRIPTION

The main components of the system include RFID tags, RFID reader, Raspberry Pi, GPS module, LCD, servomotor etc. Brief descriptions of each are given below:
1.RFID Tag: RFID tags are the components which are utilized for the purpose of identification. The tag has a microchip and an integrated antenna. Corresponding to each tag, the microchip contains unique digital data. The most significant feature of RFID tag is the uniqueness exhibited by each of them. When the tag is read, digital data in the chip is send through radio frequency interference technique. These cards may be of different size and range. Passive tags with no batteries have long life and shorter reading range and are ideal for mass identification process giving the advantage of low cost. Cards shaped S50 RFID cards are ideal for the usage here.

2. RFID Reader: The unique digital data of tag is decoded with the use of RFID reader. The RFID reader transmits an electromagnetic wave which is input to the tag. RFID tag is energized due to these electromagnetic waves hence resulting in the production of a confined magnetic field, which has an interference pattern. This interference pattern which when read by a RFID reader would produce the unique number assigned to the RFID tag and thus the address of the tag is obtained. It should be noted that the address defers from each RFID tag as they are provided by EPCglobal and hence it offers complete resistance to duplication. Here we use MFRC522 reader for reading passive tags.

3. Raspberry Pi: The Raspberry Pi is a series of credit card-sized single-board computers. It is a low-cost, basic computer that was originally intended to help spur interest in computing among school-aged children. It is a low-cost, basic computer that was originally intended to help spur interest in computing among school-aged children. The Raspberry Pi is contained on a single circuit board and features ports for HDMI, USB 2.0, Composite video, Analog audio, Power, Internet, SD card. They are ARM based microcomputers having 40 GPIO pins and can be programmed in programs such as Python or Scratch.

4. GPS Module: GPS is the latest technology used in varies fields such as navigation, tracking and also in some of surveillance application. Here used GPS to calculate the distance travelled by the passenger. RobokitsGPS module 01 used can configured to generate the latitude and longitude of the current position of the bus. The position of the bus can be monitored continuously using this GPS module. Combining GPStechnology and smart cards we can design a complete bus ticketing system. It supports 66 Channels and external antenna input compatibility for maximum sensitivity. USB cable is included to connect with PC USB port.

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5. Modem: Any 3G USB modem can be used for getting internet connection. Network providers with more service area are preferred. But this does not affect the performance of the system as it is possible to store data and use it according to internet connection. Since GPS does not require internet connection, working of other components remain unaffected.
6. Servomotor: A servomotor is a rotary actuator that allows for precise control of angular position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Door handling system is controlled by servomotor. For heavy loads, stepper motors can be used instead. Selection of motor depends on the weight of door, its operating mechanism etc.
7. Display unit: Cheapest display unit available is LCD. But Pi has an advantage that other display units can be connected to it directly through display port.

III.SOFTWARE DESCRIPTION

Software used in this project is Python. Python is a widely used general-purpose high-level programming language. Its design philosophy emphasizes code readability, and its syntax allows programmers to express concepts in fewer lines of code than would be possible in languages such as C++ or JAVA. The language provides constructs intended to enable clear programs on both a small and large scale.Python supports multiple programming paradigms, including object oriented, imperative and functional programming or procedural styles. It features a dynamic type system and automatic memory management and has a large and comprehensive standard library.Python is said to be relatively easy to learn and portable, meaning its statements can be interpreted in a number of operating systems, including UNIX-based systems, Mac OS, MS DOS, OS/2, and various versions of Microsoft Windows 98.

IV.SYSTEM WORKING

This system consists of an RFID reader which is used to identify the passenger, a control unit which uses the database to monitor factors like account balance, ticket charge etc. The system also includes a distance measuring unit which uses the GPS to find leaving place and arriving place to calculate distance, and an internet access for updating database. Basic block diagram of the system is shown in Fig. 1.

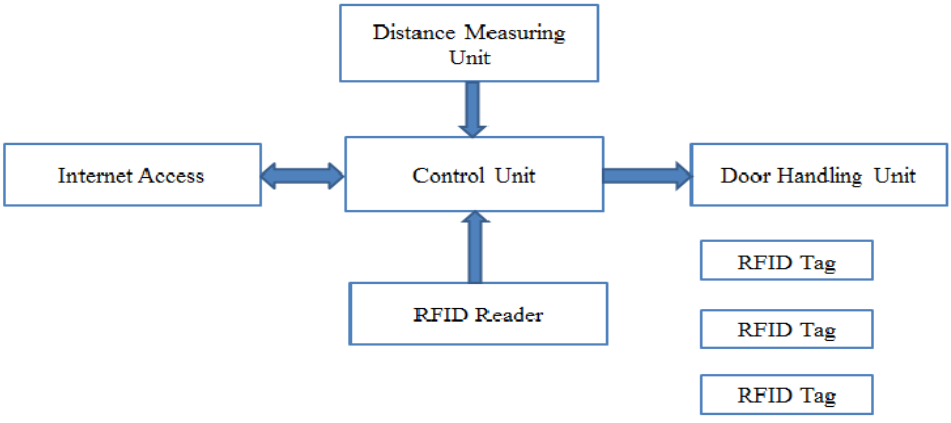

Fig. 1 Block Diagram

An RFID system consists of a tag, basically a microchip with an antenna and an interrogator or reader with an antenna. Most RFID tags contain at least two parts, One is an integrated circuit for storing and processing information, modulating and demodulating a radio-frequency (RF) signal, and other specialized functions. The second is an antenna for receiving and transmitting the signal. The passenger entering the desired bus should display/place the RFID tag in front of the reader. When the tag is placed before the reader circuit, the tag gets energized and the reader reads the unique digital data behind it. Hence the tag reveals relevant information to the reader circuit. The reader circuit stores this information in its internal memory temporarily and also links to the common database system which has all the details of the particular passenger. It verifies the identity of the person. Having linked with the common database

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system, it also checksif the passenger has sufficient balance in his account for the travel. Only a person with minimum account balance and verified identity will be able to travel in the bus which assures secure and reliable transportation system. After each travel, the individual bus unitsupdate database by transferring credit to the corresponding account and also the information can be found in the main database. Cross checking of all those information will allow better monitoring,transparency and thus reducing corruption. Flow chart is shown in Fig. 2.

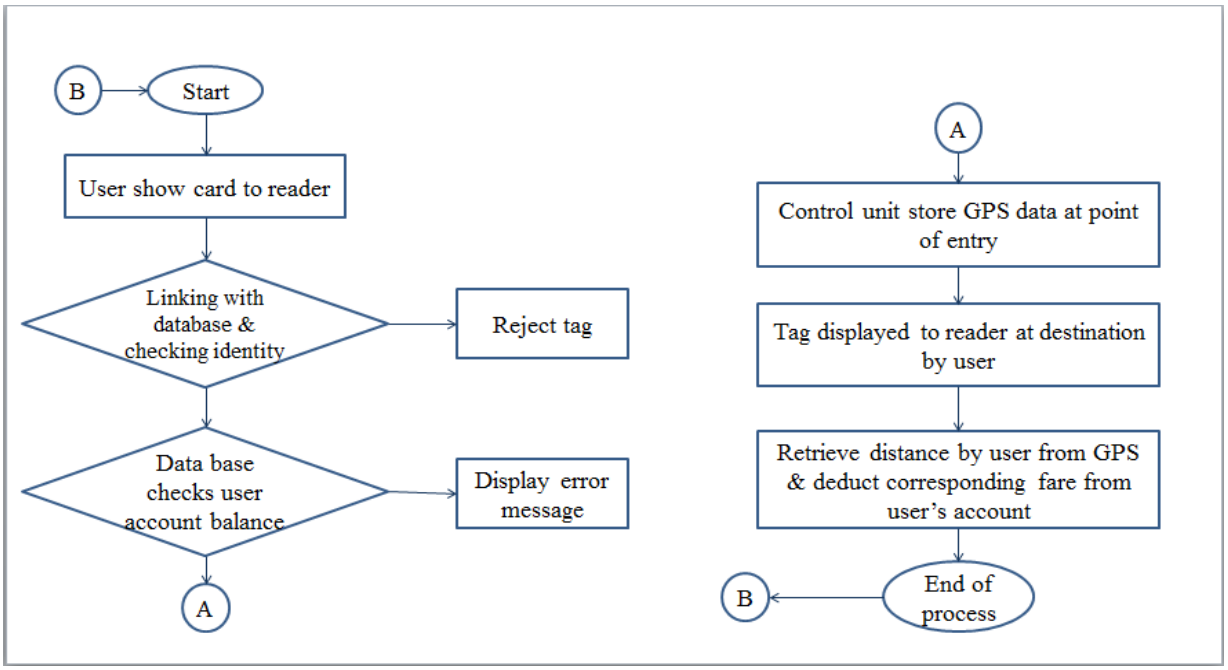

Fig. 2 Flow chart

Raspberry Pi has been chosen as control unit. It has a power processor given its size. Another attractive feature is the GPIO pins which make possible the interaction with real time sensors and actuators. It is connected to internet through a 3G modem. Low internet connectivity problems can be tackled by storing and updating the database at regular intervals whenever connection is available. GPS module, RFID reader, LCD are connected to Pi using GPIO pins. GPIO pins have features such as serial data communication (used for GPS), SPI communication (used for RFID reader), I^2C communication etc. which helps in programing in python. The effectiveness of using Pi in real time data sensing is demonstrated by Michalak S in [11].

V. RESULT

The system is fully automated, reliable, transparent and convenient. This can also be used in vehicle on highways, their toll payment and in the bus ticketing system with small modifications. The cards being reusable, they are much more convenient compared to the paper based ticketing system. The card is to be used as a universal travel pass card that will allow any transportation on any route. Initially the RFID system was made operative with Pi. Then the control over door handling with the use of RFID tags and reader are made possible.A GPS service was added for the distance measurement. Following this, a database was created and accessed via internet using a USB modem. Programs for above steps were integrated into one program. Fare calculation and internet database access were included for complete program. A model of bus was created and entire system was made operational in it. The final stage of the implemented system is shown in Fig. 3.

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Fig. 3 Implemented system

VI. FUTURE ASPECTS

The major advantage of this system when compared to previously suggested RFID based ticketing system is that this stays closer to future ticketing system. RFID system and database used here can be useful in IoT formation as object and human information collection is the biggest challenge in IoT. So implementation of such a system can be considered as primary step towards fully operational IoT. Also Raspberry Pi provides a huge room for future improvements. This minicomputer is sure to be replaced by smaller and better performing components in future, but remains the best choice till the date, considering near future. The program can be slightly modified to obtain safe travel of any transportation system such as Railways, school buses etc. Addition of speed controlling materials is preferable in cases of buses, which can be easily done when a Pi is in use. More powerful algorithms can provide real time location information in internet, ensuring in time keeping of services.

VII. CONCLUSION

This paper has presented a fully automated, reliable, transparent and convenient system for ticketing in PTS. RFID cards being reusable are much more convenient compared to the paper based ticketing system. Theseare used as universal travel pass card that will allow any transportation on any route. GPS service along with internet was used for the distance measurement and fare calculation. GPS does not require internet so is reliable even if there's no connectivity at all places of travel. Since fare calculation is done through internet, fare is crystal clear and provides no room for confusion.Database for travellers were created and accessed via internet using a USB modem. Implementing this system can be seen as a step towards IoT. Powerful program algorithm can make system to publish real time location data in internet, ensuring time keeping of services. System also holds bright promises towards different transportation fields, including transportation of school students ensuring better level of safety.

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