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An RFID Embedded Micro-controller Based Media Integration Auto- Stream Framework for Car Packing

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Abstract: This paper discusses on an integrated car parking system that provides the ultimate solution for drivers, municipalities and private parking lot owners. This enables the drivers to be guided when parking their cars at the exact place in a specified period of time; it simplifies the monitoring and also intelligence gathering of parking occupancy. The integrated RFID microcontroller functions as a vehicle parking meter, eliminating the need for parking guides directing cars on where to park. RFID based vehicles parking technique uses micro controller with sensing circuits which sense entry and outgoing of the vehicles. In this technique the RFID card is swiped with the permission of vehicle's parking owner. By using the H bridge concept we operate the entry and exit. In this H Bridge concept DC motors are used for the operation of entry and exit boom. The DC motors operate clock wise and antilock wise as per the program. When the vehicles enter in the parking system the space available in the parking system reduce and vice versa. A standard power supply of 5 volt is given for the operation. An LCD displays all the activities of the parking system. The microcontroller is interfaced to a car parking software with hashed database encryption and an RFID card authenticator recording incoming and outgoing vehicles in real-time. The use of RFID tags, readers and antennas makes it easier to automate the 'in and out' privileges of parking subscribers.

Keywords: Model, RFID, Micro-controller, Parking, Embedded

1. Introduction

The use of RFID to achieve control in parking spaces aside payment by implementing media relay at real-time with an 8051 micro-controller hasn't yet been a reality. The devices which will be used in realizing our framework is a parking management system which will be ran from the server side relying on PHP programming language. Secondly, come up with a RFID microcontroller using an 'AT89S52' which is a typical 8051 microcontrollers manufactured by Atmel. The 89S52 has 4 different ports, each one having 8 Input/output lines providing a total of 32 I/O lines (Luo *et al*, 2000).Those ports can be habituated to output DATA and authoritatively mandates do other contrivances, or to read the state of a sensor, or a switch. Most of the ports of the 89S52 have 'dual function' denoting that they can be utilized for two different functions.

The microcontroller will be integrated with the parking management system. The microcontroller ports will perform input/output operations and implementation of special features of the microcontroller like counting external pulses, interrupting the execution of the program according to external events, performing serial data transfer or connecting the chip to a computer to update the software. Each port has 8 pins, and will be treated from the parking management system point of view as an 8-bit variable called 'register' (Arangurenss *et al*, 2002), each bit being connected to a different Input/output pin. There are two different memory types: EEPROM and RAM. The EEPROM will be used to store the program,

while the RAM will store variable during program execution, that's why it is often referred to as the 'program recollection'. It is pellucid that the CPU (Central Processing Unit) is the heart of the micro controllers (Stuart, 2001).It is the CPU that will Read the program from the FLASH recollection and execute it by interacting with the available peripherals.

1.1 Statement of the Research Problem

The lack of a framework for automatically scheduling cars in the parking centres by automatically auditing available empty spaces in the parking and ushering in the next car while synchronously taking real time images and video for forensic audit has proved difficult to control parking space. There is continued use of parking guides who have to be available at all times to direct cars while moving around to check empty lots. The auditing of cars going through the gates is retrogressive as it lacks supporting real time evidence inform of media captor report. Therefore, the recording system in place is cumbersome and inefficient more often lack up to date information in case a person engages in a criminal activity. In addition, there has not been a mechanism in form of a secure model based on RFID integrating media auto-streaming for car parking.

1.2 Objective of the Study

The main objective of the study is to come up with an RFID based embedded Micro-controller framework that would aid in automatically scheduling cars in parking centres while integrating media streaming at real time.

2. Survey of Literature

Automatic identification, or auto ID for short, is the broad term given to a host of technologies that are used to help machines identify objects. Auto identification is often coupled with automatic data capture (koh *et al*, 2003). That is, companies want to identify items, capture information about them and somehow get the data into a computer without having employees type it in. The aim of most auto-ID systems is to increment efficiency, reduce data ingress errors, and free up staff to perform more value-integrated functions. There are a host of technologies that fall under the auto-ID umbrella. These include bar codes, astute cards, voice apperception, some biometric technologies (retinal scans, for instance), optical character apperception, radio frequency identification (RFID) and others.
RFID (Radio Frequency Identification) is a means of identifying an item based on radio frequency transmission (Laubacher *et al,* 2005). This technology can be utilized to identify, track and detect a wide variety of objects. Communication takes place between a reader and a transponder (derived from TRANSmitter/resPONDER - Silicon Chip connected to an antenna), customarily called “tag”. Tags come in many forms, such as perspicacious labels that are stuck on boxes, keenly intellective cards and a box that you stick on your windshield to enable you to pay tolls without ceasing. Tags can either be passive (powered by the reader field), semi-passive or active (powered by battery) (Juels, 2004). Active RFID tags are powered by an onboard powering source and incline to be more extravagant than passive tags that harvest power from the RF energy of the reader. On board power sanctions the active tags to have more preponderant communication distance and more expeditious replication time. These tags are more multifarious and customarily have more sizably voluminous recollection capacity. Passive RFID tags have no internal power source and use external power to operate. These tags are powered by the electromagnetic signal received

from a reader. The received electromagnetic signal charges an internal capacitor on the tags, which in turn, acts as a puissance source and supplies the potency to the chip.

RFID systems differentiation criteria depend on operating reader frequency, physical coupling method and communication distance (read range) (Landt &Catlin, 2001).) The communication frequency used ranges from 135 KHz long wave to 5.8 GHz in the microwave range and are classified into four basic Ranges: LF (low frequency, 30 - 300 kHz), HF (high frequency, 3 - 30 MHz), UHF (ultra-high frequency, 300 MHz – 2 GHz) and Microwave (> 2 GHz). The physical coupling uses magnetic and electromagnetic fields. The communication distance varies from few millimetres to above 35 meters (close coupling: 0 - 1 cm, remote coupling: 0 - 1 m, long range: > 1 m) [6].

In the typical configuration tags are placed on the objects to be identified (Vogt, 2002) each tag is provided with an internal memory, which is partially “read-only” and, optionally, rewritable, where the information (unique ID serial number, manufacture date, product composition etc.) about the object is stored. When these tags pass through the field generated by a reader, they transmit this information back to the reader, thus allowing the object identification (Cha & Kim,).The communication process between the reader and tag is managed and controlled by one of several protocols, such as the ISO 15693 and ISO 18000-3 for HF or the ISO 18000-6, and EPC for UHF. The identification process begins when the reader is switched on; it starts emitting a signal at the selected frequency band (typically 860 – 915 MHz for UHF or 13.56 MHz for HF); the tags reached by the reader’s field will “wake up” (supplied by the field itself, if passive). Once the Tag has decoded the signal, it replies to the reader, by modulating the reader field (backscattering modulation). If many tags are present, then they will all reply at the same time. If this occurs, the reader detects a signal collision and an indication of multiple tags (Vogt, 2002). In this case the reader uses an anti-collision algorithm designed to allow tags to be sorted and individually selected. The number of tags that can be identified depends on the frequency and protocol used, and typically ranges from 50 tags/s to 200 tags/s. Once one tag is selected, the reader can perform all the allowed operations such as read the tags identifier number, or also write data in it (in case of a read/write tag). After operations on the first tag are finished, the reader starts processing the second one and so on until the last one.

In order to receive energy and communicate with a reader, passive tags use either one of the two following methods. These are near field, which employs inductive coupling of the tag to the magnetic field circulating around the reader antenna (like a transformer), and far field, which uses similar techniques to radar (backscatter reflection) by coupling with the electric field [9]. The near field is generally used by RFID systems operating in the LF and HF frequency bands, and the far field for longer read range UHF and microwave RFID systems [9]. The reason is that in the near field, the field energy decreases, as a first approximation, proportionally to 1/R3 (where R is the distance from the antenna), while in the far field the energy decreases proportionally to 1/R; the borderline between near and far field as a result, in the far field the energy of lower frequencies waves will turn out to be much more reduced than that of higher ones, whose use is thus mandatory in that zone. Passive technology is most widely used for RFID applications. Passive technology operates in a range of frequency bands, of which 860 – 956 MHz (ISM) band is most popular. Passive tags operating at UHF communicate with the reader through Amplitude Modulation (AM), and receive their power from the reader field, with energy transfer based on the far field properties. Communication from tag to reader is achieved by altering the antenna input impedance in time with the data stream to be transmitted: in this way the power reflected back to the reader is 3modulated in time with the data (Van, 2007)

The use of far field backscatter modulation introduces problems that are not present in HF and lower frequency systems (Rao, 1999) One of the most consequential of such

undesired effects is due to the fact that the field emitted by the reader is not only reflected by the tag antenna, but additionally by any objects with dimensions in the order of the wavelength used: these reflected fields could damp the reader's and the back scattered field thus reducing the system's efficiency; for this reason, it is better to utilize more than just one antenna per reader. ISO defines the Air interface communication between Reader->Tag and Tag->Reader, and include parameters like Communication protocol, Signal Modulation types, Data coding and frames, Data Transmission rates and Anti-collision (detection and sorting of many tags in the Reader field at the same time) Floerkemeier, (2006).

2. PROPOSED FRAMEWORK

The proposed framework for efficiency in car packing while integrating media streaming is as shown below. The layout of the framework will be as shown below in Figure 1.

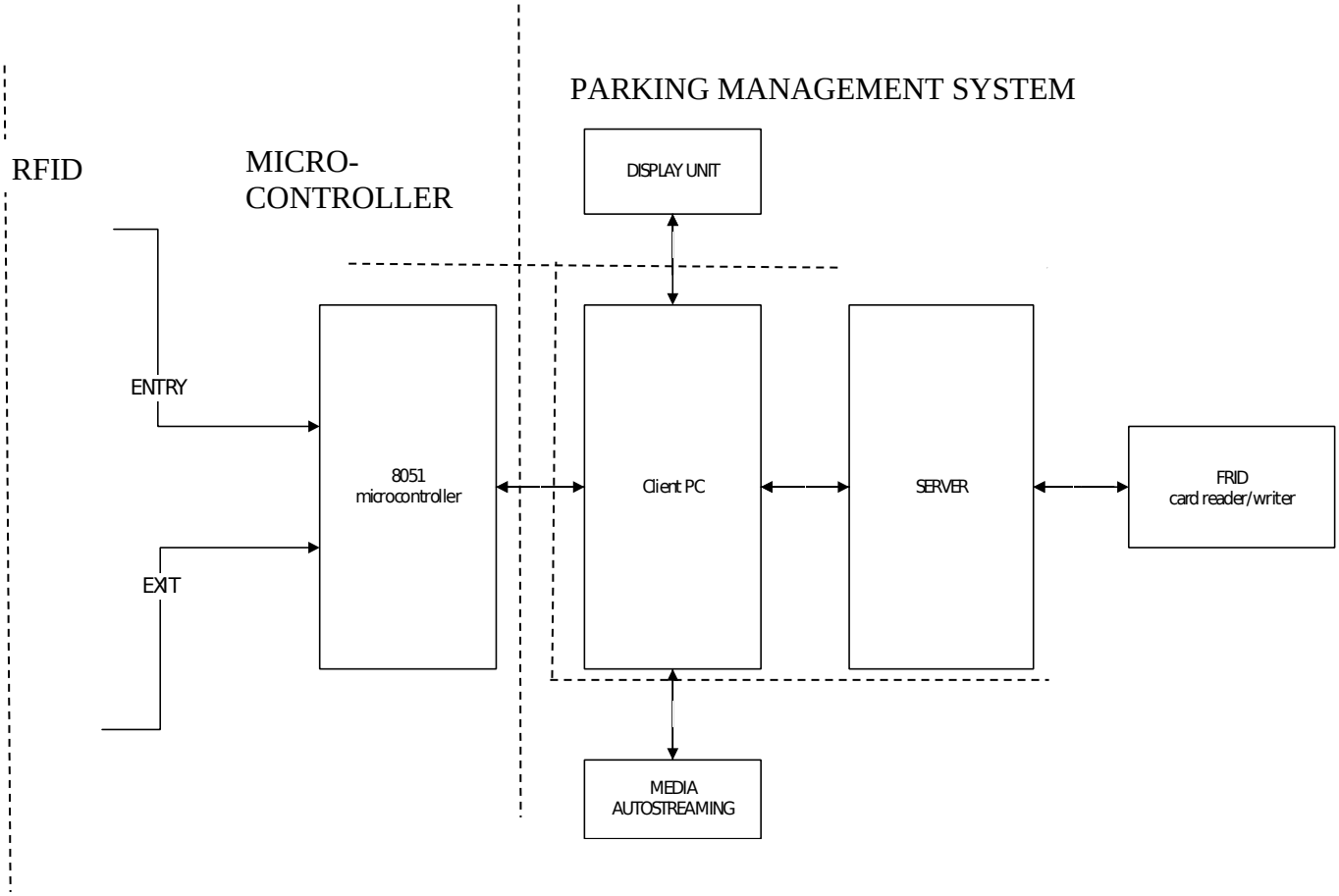


Figure 1: Framework of RFID with Media Integration

The process starts from the gate when a car entrant takes the RFID card and swipes through the reader which in turn relays the signal to the microcontroller and once the microcontroller processes the signal it uses a system of relay to trigger the stopper to let the vehicle enter the parking centre. The micro-controller simultaneously based on the instructions pre-programmed will convey signals to the server which directs the media auto streaming to begin. When the taking of photos is being done the vehicle is led to the parking centre by being shown on the screen interface the parking space allocated as per the

time and schedule. At the time of entry the cameras are focused on the vehicle registration number which are send to the database of the parking management system for retrieval in case of any audit.

1.1. Methodology – the Verification framework

Our framework will be such that it will be apportioned sections as per activity laid out. The activity functional sections are as listed below;-

i. Entrance Control Part-Automatic car, vehicle detector, ARM controller, remote reader, automatic card machine
ii. Exit Control Part-Automatic car, vehicle detector, ARM controller, remote reader, hard, time card reader
iii. Image contrast section-Camera, video capture card, image contrast module
iv. Guard-Charge management computer, RS485 communication card, parking management software, time card reader, switches, etc.
v. Management system-Central server, RS485 communication card, card management software

1.2. Data flow logic

The logic of the process flow from request of information by buffering the RFID tag over the reader and subsequently relay of information to the opening of the gate and letter exit of the vehicle from the parking centre is a shown below.

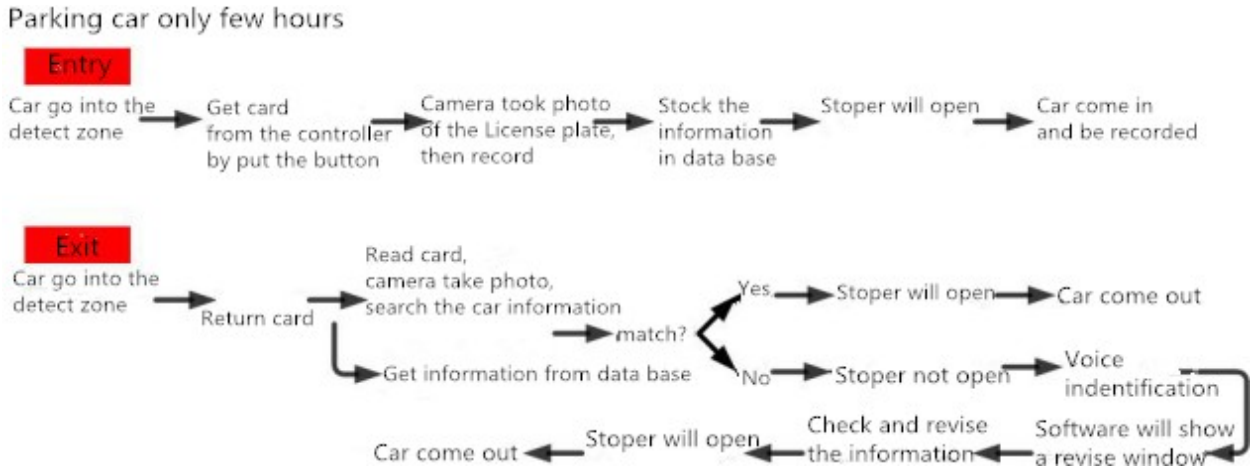


Figure 2: Data flow RFID with Media Integration Framework

3. FRAMEWORK OPERATION

We have discussed the operation of the our framework below based on specific activities taking place from the time a vehicle enters the parking centre up to exit from the centre.

3.1 The condition of Entrance and Exit

In order to effectively improve the traffic rate, the entrance will use the hardware license plate automatic identification + IC read and write technology, with the block car,

import and export booths to install a computer, video card, communication conversion card and other equipment. Security guards will work in the booth, can greatly reduce the work pressure, and reduce personal safety risks, but also for the user to save human resources. To enhance the overall image of the environment. The power lines, video lines and communication cables of the imported equipment are embedded into the export booths along the entrances of the imported PVC pipes along the entrance safety island to realize the data fast, safe and stable transmission. The logical design diagram for the interface is as shown below.

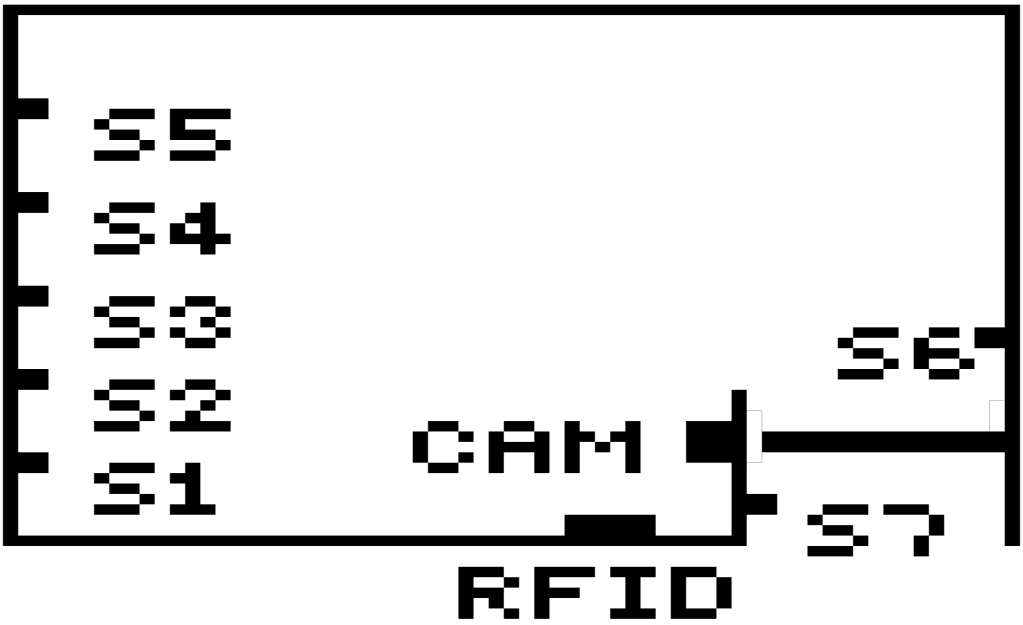


Figure 3: Logical design of the RFID, sensors and camera

a) S1 - sensor1
b) S2 - sensor2
c) S3 - sensor3
d) S4 - sensor4
e) S5 - sensor5
f) S6 - sensor6
g) S7 - sensor7
h) G1 - gate
i) CAM - Camera
j) RFID - RFID tag

This research followed a proof of concept research design. This phase involved validation of user needs, technical feasibility, identifying potential stumbling blocks, identifying what the RFID based microcontroller interfaced model for car packing would or would not provide. This helped determine the scope and level of customization necessary so

as to complete deployment of the proposed model. The design was created using a Qemu system running Raspbian on Windows 10. The source code provided for in this simulation deviated insignificantly with results even as much as there were various input sources and from real data. Figure 4 below shows design of the carpark structure that was implemented on the Qemu system.

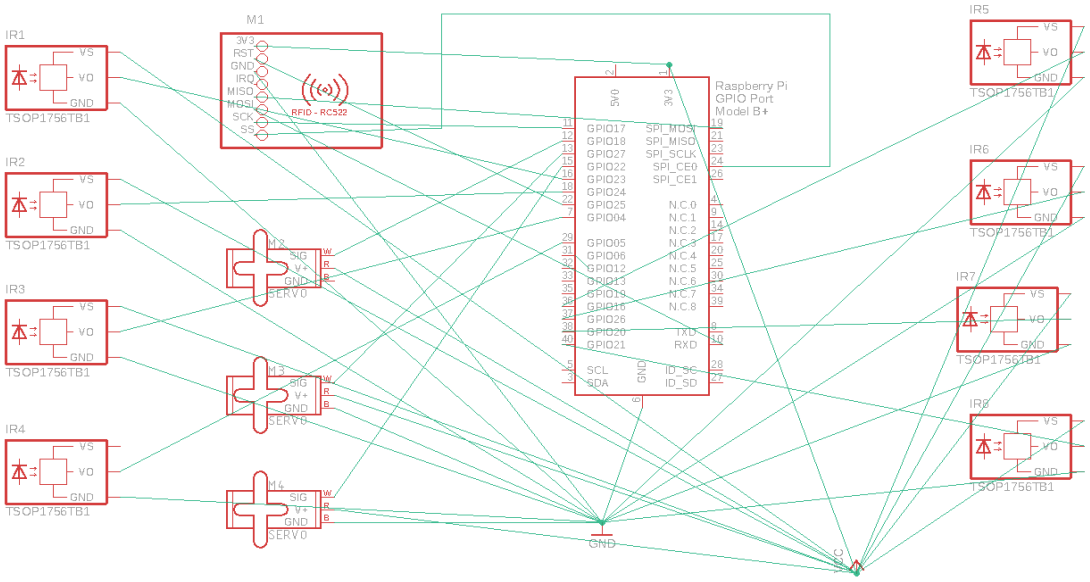


Figure 4: Design of the Car Park system later implemented on Qemu

The Qemu simulation for bus interconnection of car park structure and components and how the different components that make up the model interface with each other is discussed in the following section.

3.1.1 Design of the simulation parameters on Qemu.

The simulation flow diagram involved a precise description of functionalities and data flow from inception of car entry into the car park area, entry/exit outputs, checking of vacant car spaces, capturing of multimedia into the data repository, RFID tagging and recording, below in figure 5 indicates the circuit components and the simulated circuit of the experiment.

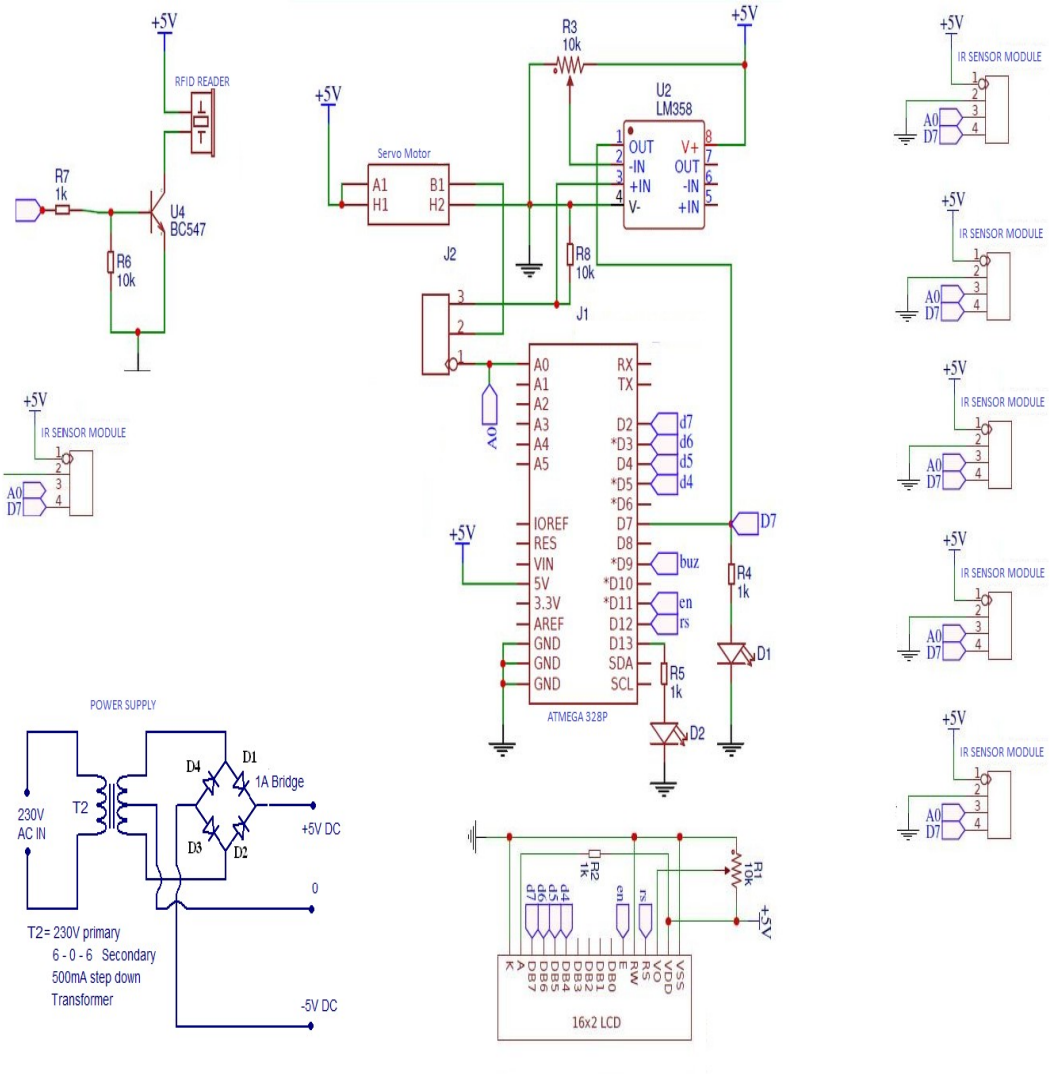


Figure 5: Qemu Circuit Diagram

3.2 Fixed Vehicle Admission

The internal fixed owners will be then issued a CDMA card as the card, the sensing distance of 3-15 meters, when the vehicle into the reader identification area, the reader to do in induction card at the same time, the camera capture images, Hardware license plate recognition to obtain the license plate number, and stored in the database to keep the query, security personnel only in the post office computer interface, to distinguish between image comparison and license plate number is consistent, to achieve fast, safe approach and appearance, , The car will automatically drop the bar, the whole approach up to 3 seconds to complete.

When the internal fixed vehicle is played, the sensor coil in front of the export control machine will first sense the vehicle. When the car enters the reader identification area, the reader can sense the card in the 0.2 seconds, while the camera captures the image, the hardware License plate recognition to obtain the license plate number, at the same time out of the car admission information, management staff according to the interface shows the entry and exit data comparison, confirmed that the same car with a card, the system automatically open the gate release. After the sense of the coil, the brake lever will

automatically fall. On the contrary, by the management personnel in accordance with internal management regulations to deal with or manually modify the information.

3.3. Regular vehicle access process

The entry process happens when the internal vehicle approach, the entrance CDMA reader remote sensing card, the system detects a legitimate card, while the image contrast system starts, the camera automatically captures the vehicle picture and identify the license plate number, while the identified license plate number and the actual license plate If the license plate is not the same as the actual license plate, the system will pop up the confirmation window, and the vehicle will enter the parking lot. If the license plate is not the same as the actual license plate, At this point the license plate number to be manually entered, confirmed after the save to the database, automatic car open, the car after the switch.

The Exit process occurs when the internal vehicle is out, the remote reader of the CDMA reader is exported, and the controller prompts the reader to succeed. At the same time, the image matching system will automatically capture the vehicle picture and identify the license plate number, and enter the database together with the information , Such as the identification of the license plate number and admission number consistent with the export automatic car to open the release; such as after the card system to verify the license plate and the admission license plate is inconsistent, the system re-capture an image, then manually enter the license plate number, Into the database, while automatically turning the car to open, after the car off the gate.

Note: The process for the standard fixed car access is such that the system is set to a fixed RFID tag to confirm through swiping against the reader at the gate, the owner of the tag after entering the gate does not automatically open until the system confirms the license plate number is correct, then automatically it will send instructions to release the stopper.

3.4 Temporary vehicle entry and exit

When a vehicle is set for a temporary stay or a short time visitor approaches, then the card reader within the card reader sensor area and the camera within the same area or camera focus and before the stopper at the gate is triggered for opening, the system voice prompts "temporary car please take the card and card admission", the owner press the button on the control panel Out of the card at the same time the system automatically stops the car and does not open the stopper, such that the card owner did not take in the 20S, then the card machine automatically swallows the card to avoid loss; when the owner takes the card instantly then the camera and the image will identify the license plate number, save to the database, Open, after the car is off the gate, the whole approach is up to 3 seconds to complete.

The Entry process occurs when the temporary vehicle approaches, the owner drives nearby to the entrance control machine before pressing the card button were the card will be presented, then the owner takes the card while simultaneously the image contrast system starts capturing vehicle images and identifies the license plate number, while the entrance gate automatically opens and allows the car to enter the parking centre.

The Exit process happens when the vehicle is exiting from the parking centre a similar reverse procedure is done were the owner drives the vehicle to the exit controller and leaves the card, and the stopper is automatically opened for exit.

The exit process interface output is as shown below in Table 1 outlined with Entrance frequency logs report interface. Slot frequency log reports helped examine the relative abundance of each particular target data within the sample RFID cards. Relative abundance represented how much of the data set was comprised of the target data. The RFID cards

used during this validation test had the following numbers A4221E6C, D654FE1A, 7D54AAC0 and 26AE59D3. The model also had the capability to present the two realtime frequency reports in line charts. The slot frequency logs report chart and entrance frequency logs report charts interfaces are shown in Table 1 and Table 2 respectively below.

Table 1: Slot frequency report line chart interface

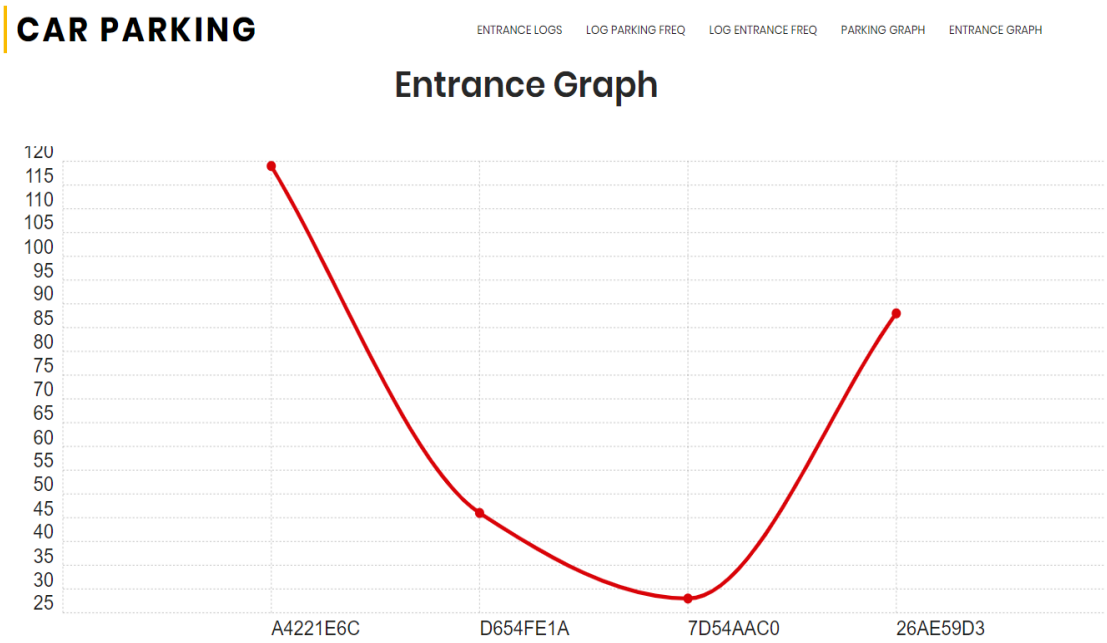
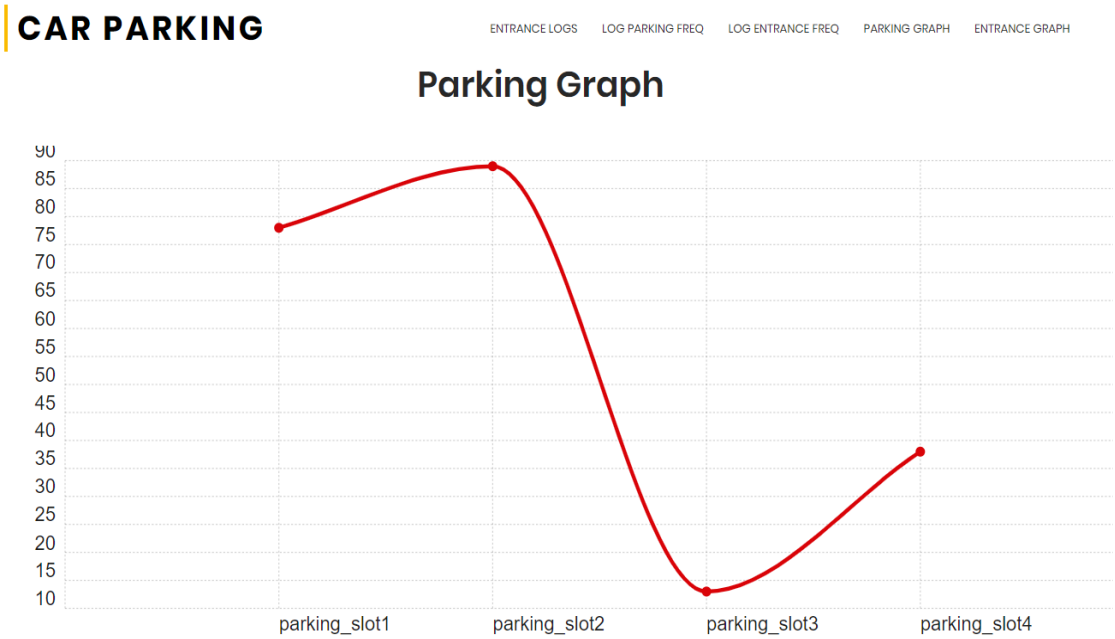


Table 2: Entrance frequency line chart interface



The longitudinal aptitude of the line graph was instrumental in helping display the real-time data in an easily interpretable format. The frequencies for the tracked events were easily plotted along the y axis. Line graphs showed a graphic representation of the rise or

fall of the data points. Missing data could also be plotted along the line with some degree of certainty or error probability.

4. DISCUSSION

The proposed framework presents a number of advantages towards parking solutions, these are:

- **Scheduling of vehicles**: It makes it possible to schedule vehicles by directing the car to the empty parking lot and also cancelling the availability such that the next vehicle cannot be issued with a vacancy.
- **Vehicle detail captor**: The system is able to take details of the car as it approaches to the parking centre by taking pictures and also video auto streaming of the vehicle entry and number plate and the type of vehicle passed can be known and sometimes possession.
- **Forensic facilitation:** The system can be used for forensic auditing by studying information available on the media database that includes videos and pictures taken during entry and exit. Also, the parking management system database can be utilized by experts for investigations.
- **Affordable operation:** The use of the parking management system which as media integration facility is relatively low cost because multiple owners and vehicles details are send through a connection into a unified system.
- **Report generation:** The use of this system can make it possible to produce summary reports of routine operations. This information is often not availably and accurate in the present setup that relies one technology.

4.1 Challenges

The main challenge facing the utilization of such a system from the stakeholders or organizations point of view is upsurge in the number of vehicles to be parked and also absence of enough parking lots can be a problem aside capital investment shortcomings.

4.2 Assumptions

The existing organizations that have already adopted the technology or followed a similar approach through servicing or contracted providers cooperates on how they have implemented their vehicular control system with technologies incorporated. Also how they control vehicles in parking centres to ensure security.

5. Conclusions

This paper discusses the possibility of using RFID with media integration for efficiency in vehicle parking centres. The framework proposed is such that the Parking Management System can be able to schedule the exact slot and time a car is and also when the car exits declares the slot empty. Therefore, this system facilitates faster scheduling and information captor and hence results in reduced waiting time and increases the efficiency of the parking space

6. Areas for Further Study

The proposed system has potential spinoffs due to it being enhanced to be utilized in electronic payments before entry to paid arenas and also in forensic information gathering for investigations in deterring crime by utilizing media auto streaming.

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