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Proc. EECSI 2017, Yogyakarta, Indonesia, 19-21 September 2017

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Integration Protocol Student Academic Information to Campus RFID Gate Pass System

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Abstract — Nowadays, security is a part that consent by many institution including academic for example in University campus, some of campus have been implement automatic system in campus area to control visitor to enter University also for the staffs and students, but the system is in standalone with introduce new gate pass. Most of University has been use Information Technology (IT) in application for academic system such as student information, registration, results information, etc. In this paper discuss on integration of student information to gate pass system then do not require new card or pass for every student to enter campus area. Gate pass system is required information to match to database that who allow entering to campus, normally a new database is create for the system. In this case, University has student and staff database including lecturer, thus to be efficient the data in existing database can be use and integration using protocol that gate pass system give a command to database as request then verification of those data. Currently, student database stored in server room and the place far away from gate pass system, in order to make it transaction faster for visitor to enter then a mini database is setup onsite of gate system, but periodic updating is require or every new update in database. Results shows, database stored in student information system is more than 30,000 number of student and transaction time is less than 1 second and in average cycle time is 5.5 seconds for motorcycle lane and 7 seconds for car, that mean time for visitor to access gate pass system for entry campus is most reasonable.

Index Terms — Gate Pass, Academic Information System, Student Database

I. INTRODUCTION

Student in Universities mostly use vehicles either car or motorcycle as transportation especially University in Indonesia. Vehicle entry and parking management system also monitoring is challenging problem due to the big number of vehicles entering campus every day. Currently the problem getting serious is stolen of vehicle (motorcycle) due to no control system at the entry and exit point, student free to ride motorcycle without checking and maybe riding belong other student motorcycle. Beside that foreign people (not student) also free to enter campus without report to security or checking, thus foreign people also one of the caused by stolen of motorcycle in campus. The problem is getting more severe day by day due to the growth number of student enrolments and increasing year by year and a high percentage of students and department own vehicle with the limited number of staff and parking lots. Due to this problem, some more problem find is the student parking, the vehicles park is not in parking area then blocking others vehicle, the responsible persons remain stuck and frustrated for the blocked vehicle owners until they get the vehicle out of the parking area. The security guards and parking staffs unable to help to this case because of lack monitoring and management systems also enforcement policies to the parking system. Due to this, it takes much time in pursuing the responsible person which consequently results in the wastage of precious time of students as well as faculty and staff members.

Another issue facing is uncontrolled people entering to campus area, security guard and parking staff can not differentiate which is student, staff, lecturer and visitor as well as people just passing by to campus area. This might happen for the campus area then inconvenience and also very risk to stolen of campus asset either in the building (class room) or outside the room. The damaged of vehicle in campus area owner still remain unsuccessful in finding out the responsible persons for damaging their vehicles and no one can help out in this concern because there is no proper monitoring system that can keep record of the in and out information. Furthermore, in case of suspected vehicles (involved in any criminal activity) are unable to trace out by current enforcement as there is no record or method to identify them. Thus, finding out a vehicle in such problem without any implement automated management system is results in anger, exasperation and wastage of time and it is also difficult and time consuming task to do it.

In this paper we have proposed a parking and automatic gate system (integrated to all gates in University campus). The automatic gate system use existing student information system database and student Identity (ID) that have been deploying for some time ago. This method and solution is proposed because to utilize of student ID function and make a single card to access in campus area. Student academic information system (SIKAD) with numbers of database and updated every transaction then send data to parking system used computer networking. Automatic gate system is able to monitor and record every single transaction for every student passing the gate. This system connected to all gate and every gate consist of several number barrier gate either for car or motorcycle. In the end of month University campus management easy to track and monitor who entering and passing in campus area, then security enforcement can be done base on this recommendation.

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II. RELATED WORKS

Several number of related work have been studied related to this topic such as wrote in [1] discuss on automatic process of toll collection will save time, effort, and man power. Propose a low cost and efficient technique called Electronic Toll Collection using RFID modules that automatically collects the toll from moving vehicles when they cross the toll plaza. Another research is the use of active RFID technology for asset tracking is by attaching the tag at the asset or item with assigned a unique ID for identification. The method including for vehicles tracking system [2]. A few of active RFID readers install at strategic points or location to track asset movement and collect information when anyone of item pass by in reader coverage area, reader collect information with in reading range and send to backend system. The backend systems consist of application software, middleware and database.

Radio Frequency Identification (RFID) is among the most emerging and tremendously growing technologies in the field of automatic identification. The technology is far better than its other contending systems such as Barcodes and magnetic tapes as it provides optical communication link with non-line of sight capability. A research presents for a new design of UHF RFID tag antenna for vehicle license plate number (e-plate). The proposed e-plate does not require another gadget or equipment since every vehicle is attached with a vehicle registration plate number and this e-plate embedded together [3, 4]. Numbers of vehicles are significant increase every year and many cases of vehicle theft and missing thus Internet of Things (IoT) is a technology can be used to overcome the issues. Paper presents on the use of RFID vehicle plate number (e-plate) for tracking and management system. Started by design RFID e-plate antenna based and vehicle plate number size to achieve optimum performance by utilization of plate number size then an RFID chip attached to the plate [5].

In RFID system, reader collision problems are generally mitigated by maximizing the total effective interrogation area of an RFID reader network or by automatic adjustable frame size of reader, etc. A proposes novel anti-collision algorithm for RFID system using adaptive Bayesian Belief Networks as discuss in [6]. A novel dual-band single-layer substrate and diamond-shaped antenna is presented. The proposed antenna operates in dual-band frequency at UHF band (from 902 to 920 MHz) and ISM band (from 2.4 to 2.5 GHz), which is suitable for RFID application elaborate in this paper [7].

This paper presents an application of Radio Frequency Identification (RFID) technology and used of e-seal in a container terminal gate in to do a clearance process. RFID and Information and Communication Technology (ICT) technologies are incorporated for the purpose of identifying prime mover driver, truck (vehicle), and number of containers used e-seal. RFID data processing logic can be preprogrammed and in a real domain, the system can be dynamically programmed by automatically constructing the procedure graph nodes with those basic processes and mapping the interconnection logic according to the topology of the graph [8, 9].

Used of Information and Communication Technology (ICT) is applicable in various field, one of the application in container terminal. ICT Technology is very helpful in container terminal operation and management system for fast clearance, replacing manual operation by human and improves efficiency of operation. Discuss on RFID middleware as interface between RFID systems to Container Terminal Management System (CTMS) for identification of container then keep all information related to shipping agent and freight forwarder into a database [10]. FPGA implementation and validation of an RFID authentication protocol based on elliptic curve (ECC) encryption scheme, illustrate the effectiveness of the implemented architecture in the car key systems [11].

Wireless communication and the speedy development of micro-electro-mechanical system (MEMS), the wireless sensor network (WSN) has aroused enthusiasm in the world for intelligent transportation system. Discuss on hardware and software design principles of the system. It has produced the wireless long-distance automatic monitor sensor network design realization plan, low cost, economic and pragmatic and high reliability [12]. Propose a multi-protocol RFID tag simulation platform which can simulate multiple UHF tag signals almost simultaneously. The simulation platform is based on a multi-processor hardware target which consists of a Texas Instruments TMS320C6713 digital signal processor and Altera Stratix II EP2S60 FPGA. The tag simulation platform could be used to verify UHF RFID system performance and collect processing data for further analysis to improve anti-collision or security algorithm [13].

Directivity design of RFID tag antenna using side-view mirror for vehicle to solve the problem of radiation variation by the front frame conductor. Especially, the calculated radiation patterns are varied by conductors which are the front frame and body of the vehicle. Theoretical approach for vehicle RFID tag system will be measured and studied continuously [14]. Application of Near Field Communication (NFC) technology to premises Halal certification, with NFC chip attached into the Halal certificate at premise with frequency 13.56 MHz, then customer or authority easy to check authentication of Halal certificate hold by premise. Another advantages this system is authority easy to spot check, either Halal certificate have been renew or authentic by premise is just tap by mobile phone or handheld reader then connect to authority database [15].

III. RFID GATE PASS SYSTEM DESIGN

The design of RFID gate pass system is conduct at campus which is Islamic University of Riau (UIR) as case and pilot project, currently UIR have been implementing online system for student management system, and thus the data for every student is recorded in a database. In order to utilize existing student data then RFID gate pass system use student ID as recorder at student Identity (ID) that every student have it. With student ID, this card can be used to enter campus area that every gate installed RFID system and barrier gate. Valid data will allow student to enter campus area, then invalid ID because of something else, student have to report to office for

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further action. Used of student ID card make it simple and reduce developing time because every data for student is available and just to import to gate pass database system. Furthermore, Lecturer and Staff as well used they ID card for gate pass to enter campus area, but for lecturer and staff maybe a bit difference and need to setup new database because there is no existing data stored in ID card. Figure 1 show a scenarios of RFID gate system installed at every entrance of campus area, there are 4 entrances in UIR.
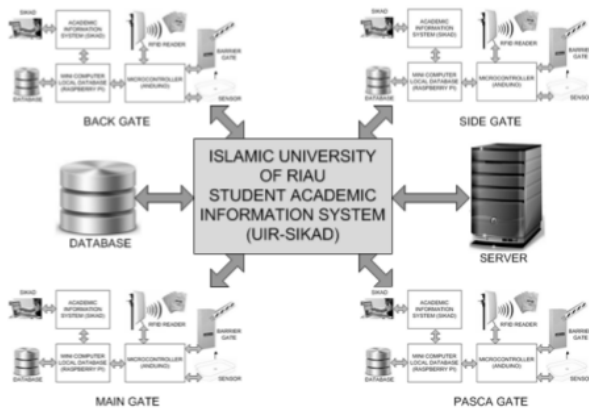
Fig.1. UIR Campus entrance area

Each gate has they own system to control who is entering campus thru respective gate, student database is stored and campus server and located far away from the gate system. Based on initial testing, online verification for person who holding the gate pass then gate system received information for validation taking long time, furthermore sometime network connection in unstable or interrupted. Thus, in every gate system set-up a local data base then verification for gate pass holder can be faster. In order to make data is real time, then updating local database is periodically or every new database added in campus system then local gate database automatically updated. Figure 2 shows a system setup in a gate; there is a barrier gate and loop sensor (vehicle sensor) to detect if any motorcycle or car passing the lane. RFID reader is installed and connected to controller to verify whether gate pass is valid on invalid, if valid by verification to local database then barrier gate will open. Vice versa if something wrong the gate pass is invalid then red light is up to notice user.
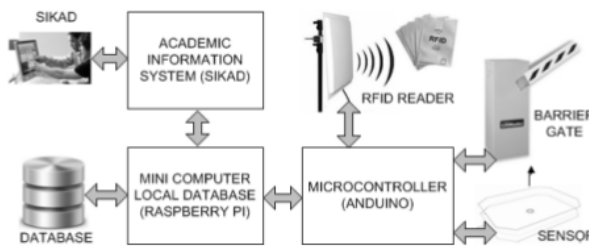

Fig. 2. Block diagram of gate pass system for campus

Figure 3 shows a student information portal in Islamic University of Riau that every student has it. The system for subject registration, payment information and all other information related to academic in campus.
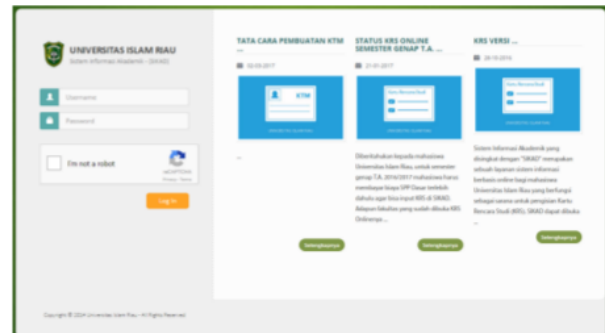

Fig. 3.Student academic information system portal

A. Microcontroller

Microcontroller is a unit based systems refine, extend or supplement human facilities that have ability to control according programmed instruction. In this gate system, instruction to barrier gate is come from database after verified user ID and microcontroller received signal from sensor (loop) installed on the road indicated that there is vehicle come in then on reader to read card (ID). When all transaction is fine then microcontroller send signal to barrier gate to on or open the barrier with green indicator light up, but when the ID is invalid or fault then red light in on indicated ID is wrong or something problem, user cannot pass the barrier. Figure 4 shows a model of Arduino used in this system, this model very costless then suitable to use for this system in order to control barrier gate.

Fig. 4. Module of Arduino unit used in this system

B. Local Database

As mention in early, student database stored in server with far away from gate system, a local database is setup to make system faster to verify user ID. In this case a Raspberry unit is used to stored data which is consist of user for gate pass then will update periodically based on data added in server. This method can do faster verification compare to do direct on server, furthermore this method can avoid if networking system is faulty or slowly during transaction. Figure 5 shows a sample of Raspberry unit used in this gate pass system.

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Fig. 5. Sample of Raspberry unit to stored user database

C. RFID Reader

RFID reader is one of main part in this system because to read and retrieve all information in user ID, this case users can be student, staff, lecturer, and community people that passing thru campus every day that issued card by University. Several model RFID reader and tag can be used to support for this system but beside model and performance cost is another issue need to be consider in designing a system. Thus, the model of RFID system use is Mifare with frequency 13.56 MHz type support to 1 kB memory and short distance reading, as the concern is to tap and go for exit campus. Figure 6 shows one of model Mifare reader used in this gate pass system, where frequency working in 13.56 MHz as standard in international regulation.
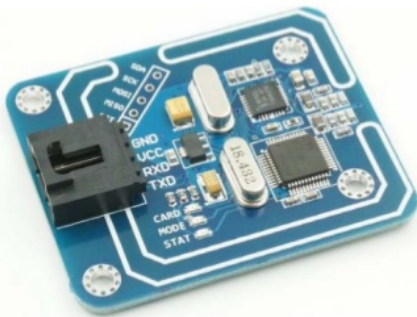

Fig. 6. One of model RFID Mifare reader used in this system

D. Process Flow

Campus gate pass system has been setup and testing conducted to check performance and several parties is used in this system such as student and staff or lecturer (user), gate pass system and academic system. Every student in University must have a student ID as identification when they do registration and also used in administration related to academic, thus the ID can be used in gate pass system integrated to student database. Figure 7 shows a process flow of gate pass system that consists of 3 parties involved. Student ID started process that every student mush have ID to enter campus area, before going to use ID card mush be write to fill information and some verification to match to the database. Once verified then student can use the ID card for entering or outgoing campus area by taping to the gate pass system. If any problem gate pass system will send error message of fault signal to inform that the card is invalid and need to check to academic office then do verification, it's maybe any penalty related to academic did by student.
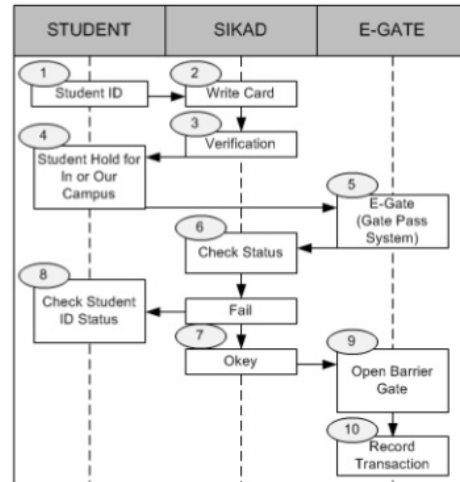

Fig. 7. Process flow at gate pass (e-gate) system

IV. RESULTS AND DISCUSSION

Gate pass system has been setup and using for student in or out campus area, initial testing give some bad response either in time or performance. Some enhancements to the system in order to fulfill standard of barrier gate system. Trial conducted to check the performance of gate pass system and also for the user side, how they use system for faster process every cycle. Figure 8 shows a lane out at main entrance that consist of two motorcycle lanes and a car lane. Based on onsite monitoring for the first trial so many student did not bring they student ID card then need to do some information that must use gate pass system to out the campus area.

Fig.8. E-Gate system for the out lane motorcycle and car

In operation campus gate pass system, there is in lanes and out lanes for every entrance of campus that every site consist of 6 lanes, which is 4 lanes for motorcycle in/out and 2 lanes for car in/out. Figure 9 shows in lanes at the main entrance with complete to the announcement and procedure to use the gate pass system. Some of data collection is done during trial and operation of system to get actual data every transaction and to be analysis in order to enhancement gate pass system either technical or policy.

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Fig.9. E-Gate system for the in lanes at main entrance

In figure 10 shows RFID reader box to tap student ID as a pass to entry or out of campus area, the RFID use is Mifare type with memory 1 kB that ability to store some student information then the main is to store student ID as identification to match to the database. This reader complete with indicator when the card tapped is invalid or fail by show RED light on top of reader cover, or GREEN light is on when the card tapped is valid or okey to be use then the card can be keep.

Fig.10. Reader system to tap student ID card

Table 1 show results of testing on the field to check performance of every gate pass system. Actually testing has been conducted many times and data recorded as shows in table 1 is some of sample data to proof that system is running well. In this case testing data only write until testing to 15th because most of the rest data has similar results.

TABLE 1. TESTING RESULTS OF GATE PASS SYSTEM

No	Testing	Lanes	
		Motorcycle	Car
1	1st	4	6.5
2	2nd	5	10
3	3rd	4.5	5.5
4	4th	7	5
5	5th	5	9
6	6th	5	5
7	7th	5.5	9.5
8	8th	8	6
9	9th	5.5	6.5
10	10th	3	7
11	11th	6	5.5
12	12th	6.5	8.5
13	13th	5	7.5
14	14th	5.5	5.5
15	15th	7	8
Average (sec)		5.5	7

V. CONCLUSION

A gate pass system has been implement is Islamic University of Riau campus which is 4 gates in all of campus area. Every gate system interconnected to campus student database for transaction verification and records any single transaction in or out of campus area for security purpose. Initial testing some of delay and slow response of barrier gate is happen due to traffic management in system for verification of data because of every gates going to a single database system. Some evaluation and enhancement is done to improve system response time to a reasonable time when users tap card until finish transaction and user out of gate area. Cycle time for every transaction of barrier gate at motorcycle lane is average 3-8 seconds and in car lane is 5-10 seconds. Every gate consist of 4 motorcycle lanes and 2 car lanes in and out, with total 4 gates in campus area is enough to serve student and staff vehicle every day without jam. Finally, systems are running well with more security for campus area especially for motorcycle users

ACKNOWLEDGMENTS

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