Development of a Clinical Registration System using RFID

Nur Umaira binti Zulkifli

Faculty of Electrical Engineering,

University Teknologi MARA, 40000 Shah Alam, Selangor

Abstract -This paper presents on the development of a prototype Clinical Registration System using RFID. The system developed was to enhance the management system in clinic and mainly proposed for Pusat Perubatan Angkatan Tentera (PPAT) in Kem 5 Rejimen Sempadan (5 RS). Most clinics nowadays are still using the traditional method that is, using pen and red card and some clinics are already implement a computerized registration system at their clinic. This latest registration system can be developed to offer more benefits by interfacing it with RFID technology. The new designed system only requires patient to scan their smartcard when registering at the counter and their personal information will automatically be updated in the system. To achieve this, both hardware and software, including database is developed suite to its objectives to show its functionality. The main development tools used for this system are ATMEGA328, Ethernet Shield, RFID module, Arduino IDE 1.0, PHP script, apache and MySQL server.

Keyword: Arduino, RFID UART, Ethernet shield, SPI, PHP, MySQL database

I. INTRODUCTION

Radio-frequency identification (RFID) use a wireless non-contact system that uses radio-frequency electromagnetic fields to transfer data from a tag attached to an object, for the purpose of automatic identification and tracking. There are two types of RFID systems which is passive and active system. A passive RFID tags do not have a transmitter; they simply reflect back the energy (radio waves) that are coming from the reader antenna. While for the active tags, they have their own transmitter and a power source, usually a battery. A radio transmitter that contained in the RFID chips emits a coded identification number when queried by a reader. The tag contains electronically stored information that can be read up to several meters away.

Technologies of identification by radio frequencies (RFID) have been used extensively in many applications and experienced a fast development. In the field of healthcare it is expected to be one of its major growth areas. Other than that, we can see many RFID systems are used in asset tracking, payment system, security and access control, retailing, toll system, and many more.

In the present days, most of the clinics are using either manual or currently computerize approach. Both of these methods require a clinic staff to register each patient who wants to meet the doctor for a treatment. With the introduction of the new registration system using RFID, patient can now register in less than one minute just by scanning their smartcard. This smartcard are given to them on-their first day of visit to the clinic. The hassle of waiting or standing long while registering will be avoided with the implementation of this smartcard. As for the first timer to the clinic, their information will be manually key-in to the system by the clinic staff.

The objectives of this project are to develop a complete clinical registration system using RFID technology with a basic database system that easily understood user interface, a low cost registration system using Arduino and finally obtain the correct outputs.

The clinic registration system using RFID has never been applied in any clinic in Malaysia, to be specific. With all the benefits offered, this system is appropriate to be use in small and big clinics. This system can be further developed to provide many more applications suite to the demand.

II. METHODOLOGY

The clinic registration system is basically consisting of three main components; ATMEGA328 microcontroller, RDM6300 UART RFID module and Ethernet shield W5100. In the following sub-section, all the explanation about the requirement of this project in terms of hardware and software parts has been detailed.

A. *Hardware system*

The block diagram of a complete system and its schematic diagram are shown in Fig. 1 and Fig. 2. The brain of this clinic registration system is the

microcontroller ATMEGA328 by ATMEL. This microcontroller is chosen because it is supported by Arduino board. Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software [1].

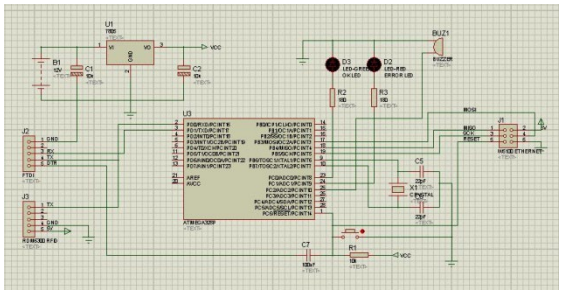

Fig. 1 Schematic of whole system

RDM630 ATMEGA328 W5100

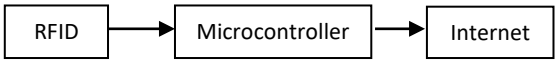

Fig. 2 Block diagram of system

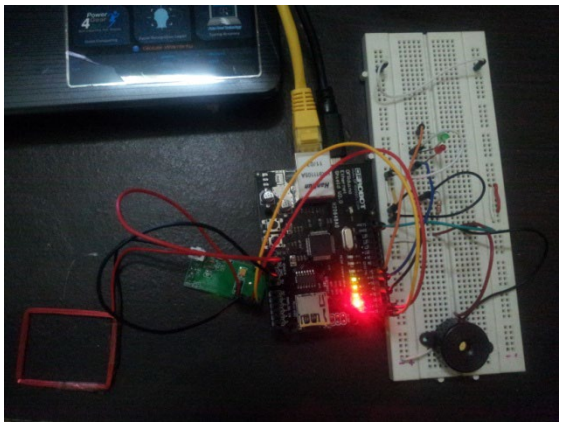

Fig. 3 Wiring of the whole system

There are two modules used in this project. One of the modules is RFID module RDM6300 - UART that is used to interface with the microcontroller. It is a passive-low cost RFID module that is perfect for connecting to an Arduino because of its simple wiring thus allowing simpler programming. The RDM6300 RFID module support EM4100 compatible read only or read/write tags. These passive tags operate at low frequency system of 125 kHz which are ideal for applications where the tags need to be read through material or water at close range [2]. The maximum effective distance between the tags and reader is approximately five centimetres away. The Universal Asynchronous Receiver/Transmitter (UART) control a computer's interface using a single wire.

Fig. 4 RFID module RDM6300 - UART

Fig. 5 RFID cards, each contain its own unique ID code

To allow an Arduino to connect to the internet, the Ethernet Shield that run at 5 V was used just by plug in the module onto the Arduino board, and connected it to the network with a Category 5 Ethernet cable followed by few simple instructions. The Ethernet controller of this module is Wiznet W5100 which provides a network (IP) stack capable of both TCP and UDP [4]. Arduino communicates with W5100 using the SPI bus (through the ICSP header) that was on the digital pins 11 (MOSI), 12 (MISO), and 13 (SCK). Pin 10 is used to select the W5100. SPI enables the serial exchange of data one bit at a time between two devices, one called master and other called a slave as shown in Fig. 7.

Fig. 6 Ethernet shield W5100

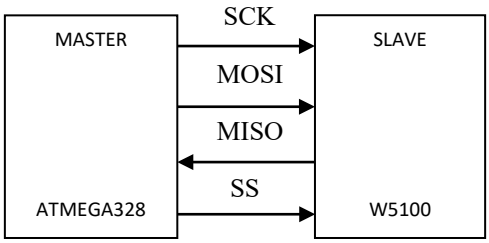

Fig. 7 SPI bus between ATMEGA328 and W5100

Patient is required to scan their smart tag to register their name in the system. Buzzer will sound and green LED will turn on to indicate that patient's information has been recorded to the system while red LED indicate there is some error with the registration. For the first timer or invalid registration, patient will need to register manually at the counter.

Once the RFID tag has been successfully scanned, the data will goes to the microcontroller to be processed and Arduino will be connected to the Internet through W5100.

B. Controlling software

Arduino is used because it offers a simpler language, similar to C++ with some slight simplification and modifications. Arduino is an open-source electronics platform. Therefore there are a lot of libraries that can be used by any designer for their design or project, including libraries for RFID and Ethernet to become a functioning system.

A program to run and control both modules are verified and uploaded to the microcontroller by using Arduino IDE 1.0 software.

Firstly, a simple sketch is uploaded to the microcontroller to obtain a unique code of the RFID cards. Each card has its own unique ID that will be used to represent each patient. When the card is placed near a reader, the result is viewed on the serial monitor of COM1 as shown in Fig. 8.

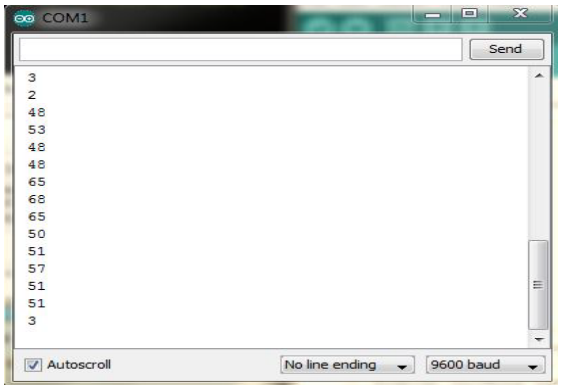

Fig. 8 Reading of RFID card unique ID

Secondly, a sketch from Arduino IDE example named as "WebServer" is uploaded to test whether Arduino is successfully connected to the internet. Realterm software was used to view the status of the connection. Example in Fig. 9 shows the unsuccessful connections due to disconnecting SS pin (digital pin 10) from microcontroller to W5100. It keeps on running as long as it is failed to connect to the web server. While example in Fig. 10 shows the status of a successful connection to the server between Arduino and internet through the Ethernet Shield. IP address of the module is set to be 192.168.0.203 while 192.168.0.1 is IP address that has been set for PC.

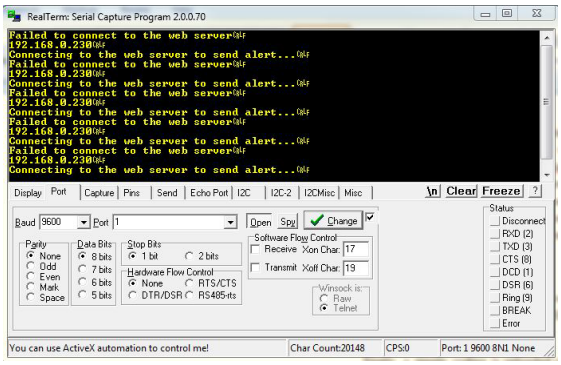

Fig. 9 Example of the unsuccessful connection to the web server

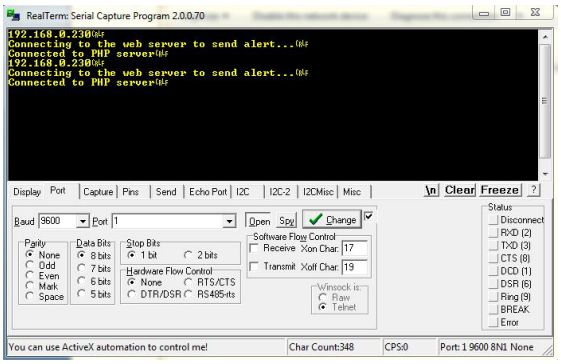

Fig. 10 Example of success connection to the web server

Database can be managed through two ways which are by using Navicat for MySQL software and directly from the Chrome browser by Xampp. Fig. 11 and Fig. 12 show the examples of managing database using Navicat and Chrome. Navicat can also be used to see data that is sent to the database using SQL language has been received by PHP.

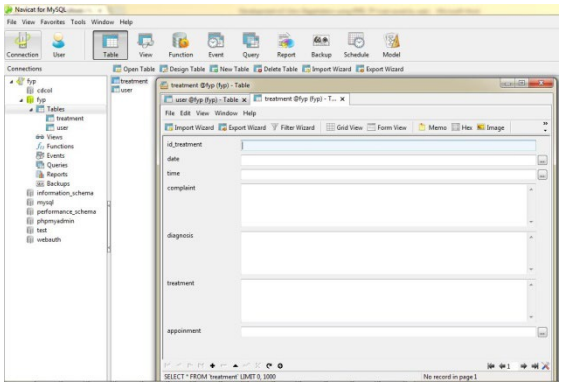

Fig. 11 Manage database through Navicat for MySQL software

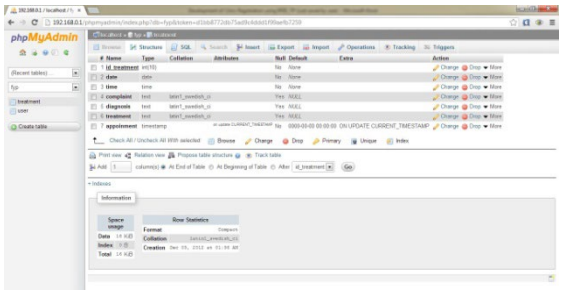

Fig. 12 Manage database through Chrome browser

Some variables are set to be unique as patient's unique identification to prevent the same data to be kept in the database. For examples, the number of patient's identification card and their home address.

Database is interfaced with Adobe Dreamweaver to obtain the code to be manipulated by Arduino.

III. RESULTS AND DISCUSSION

After scanning card, the serial monitor will display the status of the connection either passed or error. Figure below shows a success reading of two different cards. The unique number of each card was also displayed on the serial monitor. This number is used for patient's identification.

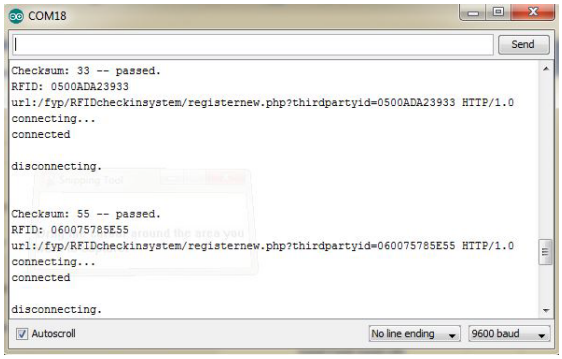

Fig. 13 Successful connection between Arduino and PC

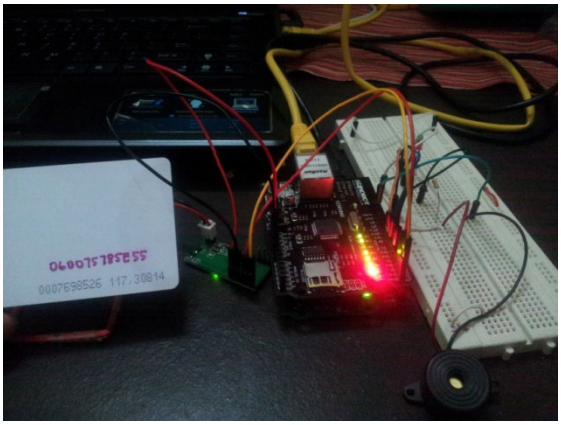

Fig. 14 Scanning and reading card by Arduino

There are three sections of results built to test the functionality of the clinical registration system using RFID which are registering new patient, adding patient name to a waiting list and write medical report.

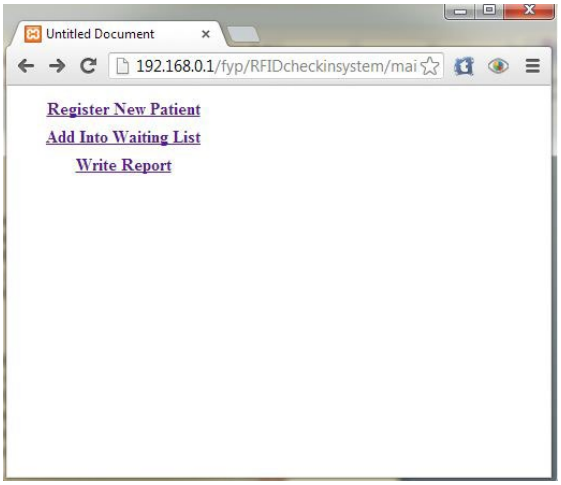

Fig. 15 Basic home page of clinical registration system

i. Registration

Patient form as shown in Fig. 16 below will be filled in by a clinic staff to register the first timer patient. The first thing clinic staff needs to do is to scan the RFID card to obtain the unique number which automatically filled in the 'ID no' column. The rest of the details required will be keyed-in manually by a clinic staff. When the submit button is clicked, all data were kept in user database.

This step is only applicable for a new card and only one card is saved at one time.

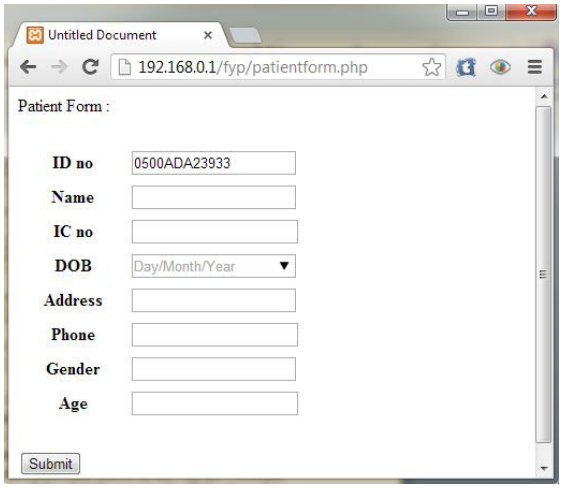

Fig. 16 Patient form to be filled by clinic staff

Fig. 17 Example of patient form after filled by clinic staff

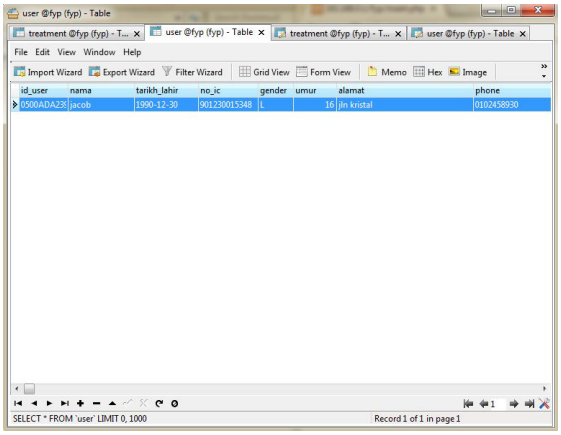

Fig. 18 Database of patient informations that succesfully registered

ii. Waiting list

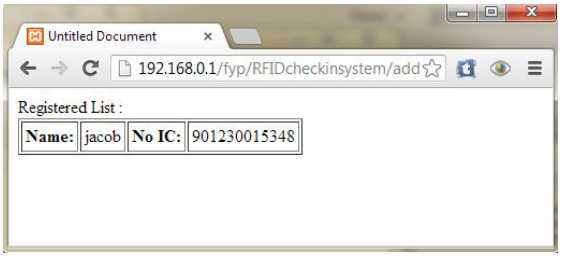

Fig. 19 Name of registered patient displayed on server

iii. Medical report

In this section, this form must be filled by a doctor in charge except for the ID number that automatically read and update by a system.

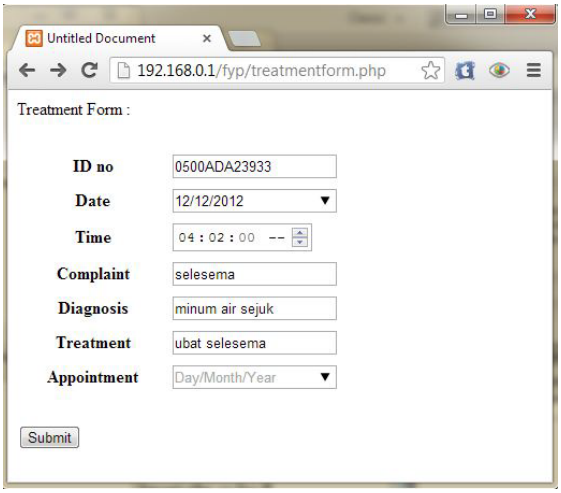

Fig. 20 Example of treatment form filled by a doctor

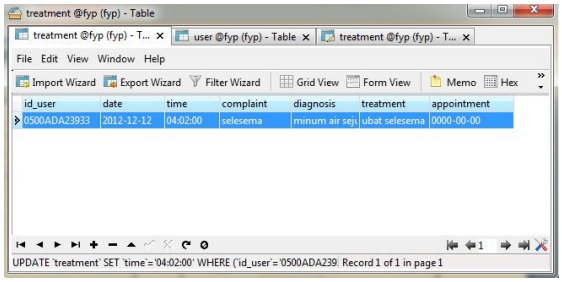

Fig. 21 Treatment database, keep all the medical information of each patient.

IV. CONCLUSION

A prototype clinic registration system using RFID was developed. The preliminary testing of the system shows that this low cost system is able to enhance the management system in clinic. Thus this simple tool can facilitate easy registration system which allows administration work to become more organized and efficient such as prevention of data loss, easy track and trace of patient's data, and also updating the patient's information. Thus, this system proves to be capable of providing a better system compared to the current or traditional approach.

V. FUTURE DEVELOPMENT

There are many things that can be done to improve this system in the future. The communication method is not only limited to UART. ATMEGA328 microcontroller is also allows SPI and I2C communication to meet the designer's need. As for the software part, the database system can be update to provide more applications to the web server such as list of medicine, two-way communication between clinic and patient and many more. It is also recommended to make this smart tag a multi-purposed card, that is, apart from using as registration; it can also function as a debit card for treatment payment where the credit value can be added or top-up up at any time at the clinic's counter. To achieve this objective, designer must use a card that support read and write function.

REFERENCE

[1] Arduino, Home Page, http://www.arduino.cc/

[2] RFID Journal, The Basics of RFID Technology from http://www.rfidjournal.com/article/view/1337/2

[3] Sparkfun Electronic. FTDI basic Breakout – 5V, from https://www.sparkfun.com/products/9716

[4] Arduino, Ethernet Shield from http://www.arduino.cc/en/Main/ArduinoEthernetShield

[5] Jonathan Oxer, Arduiono Shield List, DFRobot Ethernet Shield from http://www.shieldlist.org/dfrobot/ethernet

[6] Arduino, Ethernet Library from http://arduino.cc/en/Reference/Ethernet

[7] Autodesk, Inc., Adding ICSP header to your Arduino/AVR board from http://www.instructables.com/id/Adding-ICSP-header-to-your-ArduinoAVR-board/step3/ICSP-header-pinout/

[8] Autodesk, Inc., How to Connect Arduino and RFID from http://www.instructables.com/id/Arduino-and-RFID-from-seeedstudio/step3/The-code/

[9] DIYTech2012, More about RDM6300, RFID Reader with Serial TTL Output (2) from http://diytech.net/2012/11/27/lebih-jauh-tentang-rdm6300-rfid-reader-dengan-output-serial-ttl-2/

[10] Ryan Winters, Jameco Electronic, Building Your Own Arduino Circuit from http://www.jameco.com/Jameco/workshop/JamecoBuilds/arduinocircuit.html

[11] John Boxall, Tronixstuff, Moving Forward with Arduino – Chapter 15 – RFID Introduction. From http://www.jameco.com/Jameco/workshop/JamecoBuilds/arduinocircuit.html

[12] Erack Network, tizag.com, PHP/MYSQL Tutorial from http://www.tizag.com/mysqlTutorial/index.php

[13] The PHP Group, PHP, mysql_list_fields from http://php.net/manual/en/function.mysql-list-fields.php