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RFID SECURITY SYSTEM FOR DOMESTIC APPLICATIONS

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ABSTRACT

Radio-frequency identification (RFID) is the wireless non-contact use of radio-frequency electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information. Some tags are powered by and read at short ranges (a few meters) via magnetic fields (electromagnetic induction). We use the RFID reader to display a door lock mechanism for domestic applications using an Atmega 328(Arduino) microcontroller.

Keywords: *RFID, Security System, x-bee module*

1. INTRODUCTION

Radio-frequency identification (RFID) is a technology that uses communication via electromagnetic waves to exchange data between a terminal and an electronic tag attached to an object, for the purpose of identification and tracking. Some tags can be read from several meters away and beyond the line of sight of the reader. Radio-frequency identification involves interrogators (also known as readers), and tags (also known as labels). 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 other is an antenna for receiving and transmitting the signal. Nowadays RFID systems are used for asset management, inventory control, security system, animal tracking, keyless entry, automatic toll debiting. RFID is wireless, means non-contacting technique range from inches to feet. Tag and reader can be reusable as it is programmable device. The project is based on the principle of An Active Reader Passive Tag (ARPT) system which has an active reader that transmits interrogator signals and also receives authentication replies from passive tags. There are several other security systems such as biometric scanners, retina scanners, voice recognition, barcode scanners etc. However, the RFID module is much more economically feasible, and is very standardized, i.e. it does not vary from person to person.

2. SYSTEM MODEL

Figure1 shows the system model of an RFID tag reader. It also gives a brief explanation of the series of events that take place through the RFID security system. First, the tag is read by the given card reader. Then, the information is collected by the Arduino (Microcontroller used) through the x-bee communication module. The microcontroller decodes the received information and compares the received card number with the information stored in the database. If the card number matches a card stored in the database then the microcontroller opens a door by controlling a servo motor. If the card matches then it also displays all the database information on the screen.

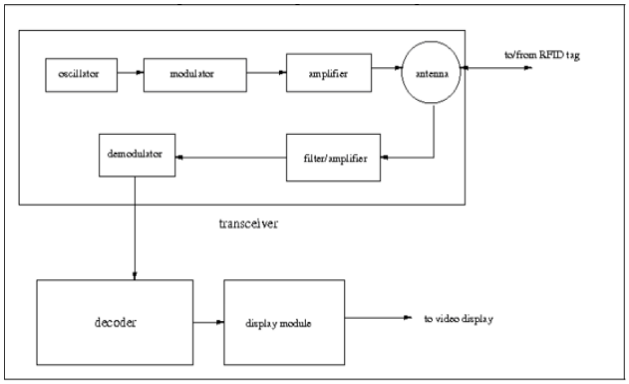

Fig.1. Block diagram for RFID tag reader

3. MATHEMATICAL ANALYSIS

The servo motor used is controlled by pulse width modulated (PWM) signals supplied by the microcontroller. The PWM signal has three separate components, namely, a voltage, V_{PWM} - the value of the 'on' or high voltage level (typically between 2 ~ 5V if PWM signal is produced by a microcontroller / CMOS logic), a frequency - the period of one clock cycle, i.e. one high pulse and one low pulse and a Duty Cycle - the ratio of the on-time

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to the off-time. The resulting voltage, which is seen by the motor, is the average voltage over the period. It is easily calculated using the following formula:

$$V_{OUT}=V_{AVG} = V_{PWM} * (\text{Duty Cycle}). \quad (1)$$

We can see from the formula that we can adjust the voltage by changing the Duty Cycle. For the given motor, we have a 5V PWM signal and 20% duty cycle (since the off time is 5 seconds). V_{OUT} is the voltage controlling the servo motor.

$$V_{OUT} = V_{PWM} * (\text{Duty Cycle})$$
$$V_{OUT} = 5V * 20\%$$
$$V_{OUT} = 5V * 0.20$$
$$V_{OUT} = 1V.$$

The voltage received at the server motor will be 1V. If we want to increase the output voltage, we simply have to rearrange the given formula as:

$$\text{Duty Cycle} = (V_{OUT}/V_{PWM.}) \quad (2)$$

This means that controlling the speed of the motor, the vibration frequency and also the vibration strength, can easily be achieved by altering the PWM signal's Duty Cycle in the microcontroller. The advantage of this technique is that the microcontroller can make a simple adjustment to its output depending upon the input conditions and its program

4. RFID TAG SESSION

The RFID system consists of reader and tag. There are three types of RFID tags: passive RFID tags, which have no power source and require an external electromagnetic field to initiate a signal transmission, active RFID tags, which contain a battery and can transmit signals once an external source ('Interrogator') has been successfully identified, and battery assisted passive (BAP) RFID tags, which require an external source to wake up but have significant higher forward link capability providing greater range. Presently we are dealing with passive tags. Tags consists of a silicon device and antenna circuit. The purpose of the antenna circuit is to induce an energizing signal and to send a modulated RF signal. Our tag uses FSK modulation. This form of modulation uses two different frequencies for data transfer; the most common FSK mode is FC/8/10. In other words, a '0' is transmitted as an amplitude modulated clock cycle with period corresponding to the carrier frequency divided by 8, and a '1' is transmitted as an amplitude-modulated clock cycle period corresponding to the carrier frequency divided by 10. The amplitude modulation of the carrier thus switches from FC/8 to FC/10 corresponding to 0's and 1's in the bit stream, and the reader has only to count cycles between the peak-detected clock edges to decode the data. FSK allows for a simple reader design, provides very strong noise immunity, but suffers from a lower data rate than some other forms of data modulation.

4.1 RFID READER SESSION

The reader circuit should provide 125 KHz carrier signal to the tag and detect the modulated signal via Backscatter modulation. This terminology refers to the communication method used by a passive RFID tag to send data to the reader using the same reader's carrier signal. The incoming RF carrier signal to the tag is transmitted back to the reader with tag's data. The RF voltage induced in the tag's antenna is amplitude-modulated by the modulation signal (data) of tag device

4.2 RESULTS

Figure 2 shows the part of the code that stores the database for the given authorized cards. Also any card outside the database is denied

```
if (a_card)
{
  Serial.println("Hello Akshay!");
  Serial.println();
  Serial.println("reg no-11BEC0182");
  Serial.println("AGE-20");
  Serial.println("MOBILE NO. 9597363171");

}
else if (s_card)
{
  Serial.println("Hello Siddhant!");
  Serial.println();
  Serial.println("reg no-11BEC0297");
  Serial.println("AGE-20");
  Serial.println("MOBILE NO. 9566816600");

}
else
{
  Serial.println("ACCESS DENIED");
```

FIGURE 2. Database of stored information for registered users

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Figure 3 shows the serial port output for the given implementation. It is analogous to the LED that displays the data corresponding to particular cards.

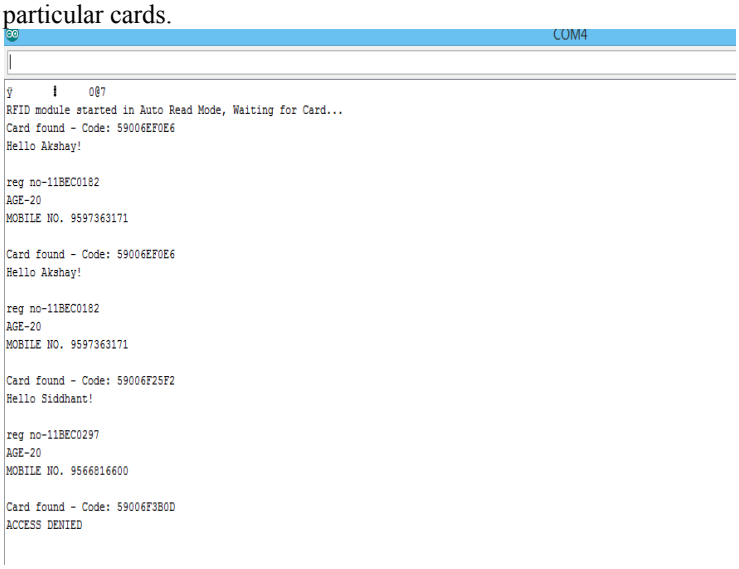

FIGURE 3. The serial monitor tested output

Figure 4 shows the case in which the card is denied access as it is not part of the stored database. The led turn's red along with the box staying closed.

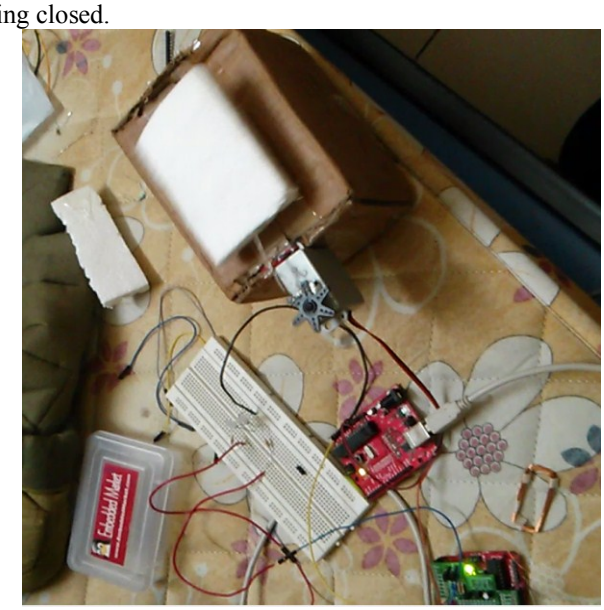

FIGURE 4. Access denied

Figure 5 shows the case in which the card is accepted .The led goes green and the box opens.

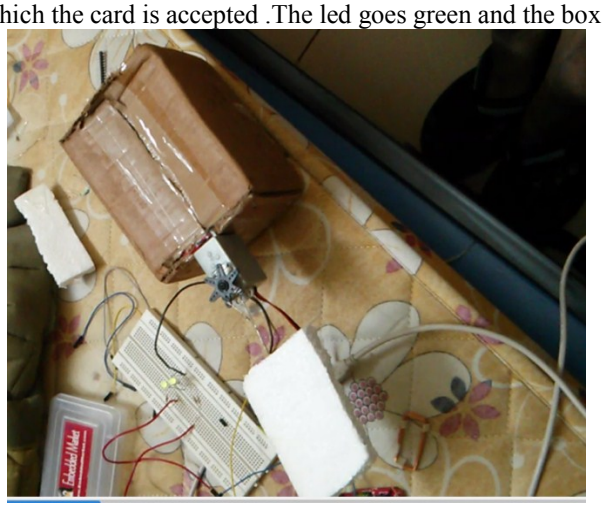

Figure 6. Access granted

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CONCLUSIONS

Thus it is observed that the RFID security system is a good basic security system. It is not very strong physically and does not have a very complicated encryption system but has a very good use in basic security, like for places which have entry on for authorized personnel carrying cards. This not only reduces a guard that has to check every id but also speed up the process. RFID proves to be indispensable for a variety of automated applications involving data acquisition and object identification. The major advantage of all kinds of RFID system is that they work contactless and require no line of sight. Transponders can be read through a whole number of substances, e.g. snow, fog, ice, paint, dirt, and in difficult constructional scenarios where barcodes or other optical reading technologies would be no use at all. RFID transponders can be read at remarkable speed even in difficult conditions, and in most cases respond in less than 100 milliseconds. The reading/writing capability of an active RFID system is also a significant advantage in interactive applications, e.g. when tracking products in process or maintenance jobs. In difficult external conditions RFID has the advantage of being able to communicate contactless and without direct line-of-sight contact with the data medium. Where the transponder is doesn't matter either -- it can be read through substances like dust, paint or ice.

Active RFID tags contain a chip and a power source while passive tags get their power from the scanner radio waves and are less costly. Both are more expensive than bar codes. The cost is justified if sensors have to read hidden or obscured tags, but for tags that are in line-of-sight for readers, bar codes and image ID are much less expensive alternatives. Image ID scanners, which read a colored dot or other image, can scan a whole pallet in seconds as long as the images are visible from the outside. While an RFID tag can encrypt its data that adds to the already high cost. Without encryption, a company's competitors or other unfriendly organizations can read the tags when the material is in transit and obtain sensitive or confidential information. Image ID systems require line-of-sight scanning like bar codes but use non-directional images. Each image encodes a unique ID that the system uses to call up individual product data from a database. Without access to the database, the ID has no sensitive information and the data remains secure.

When manufacturers insert RFID tags in products, the tag is often integrated permanently. After a sale, the tag continues to carry its ID. Consumers who purchase such a product run the risk of being tracked. Stores or other organizations could theoretically place RFID readers at their entrances and identify visitors and some of their past purchases. Bar-code readers do not have the range to scan at a distance and are more privacy-friendly in that respect.

RFID tags have problems common to all radio-frequency transmissions and the tags themselves may cause errors. Metal reflects and blocks radio waves, and some frequencies suffer from interference. More than one tag may reply at one time, causing reception errors. If all tag messages don't get through, the totals for pallets or inventories contain mistakes. Image ID systems don't suffer from the same problems. As long as the scanner can see the images, it can read them.

All the leading companies use RFID security for their employees. Furthermore even the Bangalore metro station uses RFID tokens as a ticket which also stores information about the destination. Therefore it is a breakthrough technology as it is wireless and less complicated and can be implemented and expanded in various ways

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