International Journal of Engineering & Technology, 7 (2.24) (2018) 220-223

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Smart Security System for Health Centers

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Abstract

In the modern world, Radio Frequency identification system plays a major role that automatically identifies and tracks tag attached to an object. RFID technology has been extensively used in many areas including agriculture, manufacturing, healthcare, transportation, etc. RFID system can be used in hospitals to increase the safety of patients by providing an RFID tag to the persons who visit them including doctors, nurses, and relatives. This method can be used along with a door lock but in the case of emergency, it becomes risky. Also, the same method can be used for secured access to pharmaceutical supplies which avoid illegal access to the medicines. Sensor network which is the core of IoT technology can be integrated with the RFID system to make it more efficient to be deployed in several application services. In this paper, a solution is proposed that can integrate the RFID system with the IoT technology by using IR sensors which help to get rid of illegal entry or access in hospitals.

Keywords: *RFID, IoT, IR sensors, Arduino, Security.*

1. Introduction

Securing the sensitive areas of the hospital is the most challenging effort for the healthcare organizations. No hospital is without risk and effectively managing those risks is very crucial. The need for protection of the hospital's patients, staffs, and other assets becomes mandatory. The application of RFID provides an effective solution to ensure adequate security in these areas.

The RFID is an automatic identification technology that uses radio waves to identify objects or people. It consists of a reader and a tag which can be active or passive. The active RFID tag has internal power source say a battery to continuously broadcast their own location while the passive tag that doesn't have internal power source gets energized by the electromagnetic energy transmitted by the RFID reader. The read range for an active tag is longer than a passive tag and hence it's more efficient.

The RFID technology is widely used in many areas including industries, educational institutions, healthcare, security, etc. The major purpose of the RFID is to track an object that is to be monitored. Tracking of the objects increase the visibility of the asset and also locates the object very easily mitigating the risk of theft or loss.

One of the key areas where RFID plays a major role is security in hospitals. Hospitals have limited access to certain rooms or areas in order to prevent from wandering around the facility. This is where the RFID technology comes into play. Every staff member and the visitor is provided with an RFID tag which they use to enter the area with limited access (ICU, emergency unit, stock room, labs, labs, pharmacy, psychiatry, Medical record room, Surgical services, etc). This ensures that only authorized persons enter the room. When a person wants to enter the room, the RFID tag provided to him must be placed on the reader. The reader reads the unique ID of the tag and is transmitted to the database. But there is a loophole in the system. More than one person can enter the room with the help of a single tag. This vulnerability can be overcome by using the IOT technology which uses sensors.

Internet of Things (IoT) is the network organization of physical devices embedded with actuators, sensors, and software that allows objects to be controlled remotely across the network.

IR sensor uses the property of infrared radiation to detect the changes in surroundings. We can use IR sensor to make sure that only the authorized person uses the tag to enter the room by detecting the entry of a person. Thus, no two people can enter the room with a single card at the particular instance of time. The system thus overcomes the vulnerability when integrated with the IR sensor.

2. Related Works

A lot of research work has been proposed in RFID based healthcare systems tracking and tracing pharmaceutical products, monitoring staffs, and patients with real-time locating. For preserving privacy in healthcare systems, an authentication protocol is deployed while sensing the RFID tags for identification purpose and a privacy-preserving access control method is used for restricting unauthorized access to private information. It addresses privacy issues and ensures user's personal details and assets in healthcare services [1].

RFID technology also offers many advantages over existing identification and monitoring systems. CUIDATS: An RFID-WSN hybrid monitoring system for smart healthcare environments presents an IOT hybrid monitoring system that integrates RFID and WSN providing location, status, and tracking details of patient and assets. A wristband that senses patient in real-time within the system area is designed and an RFID gateway that retransmits data from RFID reader to WSN is deployed in the real hospital [2].

Prediction of RFID adoption in healthcare supply chain from the perspectives of users plays an important role for real-time traceability, communication meeting hospital information requirements namely personality (neuroticism, conscientiousness, openness to experience, extraversion) and demographic characteristics like age and gender in healthcare supply chain. The

work was carried out by testing the model using neural network analysis [3].

The blood pressure telemetry system which is also based on active RFID tags measures average, systolic, and diastolic pressure. These active RFID tags along with ISO 15693 protocol are used to measure and process arterial blood pressure data and this data is interrogated by the RFID reader. The purpose of this was to test and monitor freely moving animals for pharmaceutical research assessment. In terms of power consumption, this system produced an outstanding performance [4].

Also, this technology is incorporated in schools to overcome the challenges of the manual method of taking attendance over a long period of time. An automated wireless approach through Radio Frequency IDentification (RFID) technology using electronic active and passive tags with suitable readers to identify and monitor the student movement by passing RFID tags through the RFID reader within line of sight. The read data are recorded to the wireless database entries and the attendance is marked. As a result, the deficiencies associated with the manual attendance system is eradicated [5].

The animal feeding behavior in commercial farms is important for maintaining the well-being of animals. The feeding visits of growing-finishing pigs at a trough are monitored automatically having passive electronic ear tags for animal identification and a high-frequency RFID system that detects multiple pigs feeding simultaneously using the anti-collision algorithm. By this way, the activity and behavior measurements in livestock are measured [6].

In mainstream applications such as maintenance of goods, security, logistics, and transportation this technology has played a vital role. It can automatically identify objects along with condition monitoring. A chipless sensor is used with a power source for sensing tagged objects. This sensor does not require any on-board micro-chip. The main objective was to use this chipless RFID sensor in numerous RF sensing applications [7].

3. Implementation

The proposed system includes both software and hardware implementation. The hardware includes an Arduino board, an RFID reader, a relay, two infrared sensors, a buzzer. The Arduino board is connected to the IR sensors, relay, and the buzzer.

The RFID refers to a small device that consists of a small chip and an antenna. The chip is capable of carrying 2000 bytes of data or less. RFID devices have an advantage over other devices like a barcode scanner. It is that the RFID card need not be positioned precisely relative to the scanner. This reduces the time consumed in reading the information from the card.

Relays are simple contact circuit that acts as a switch. The circuit is closed when they get energized. The relay circuit acts as a switch for the RFID reader. Arduino is a platform based on hardware and software. The Arduino board can receive inputs from sensors and can send outputs. The actions to be performed by the microcontroller are given by a set of instructions written in Arduino programming language.

In the Arduino board, two pins are set as input and two pins as output. The board gets input from the IR sensors and the output is sent from the Arduino to relay and the buzzer. The code is written in such a way that the relay is triggered once the IN sensor is hit. The switch in the relay is closed and hence the reader is turned on. Once the reader is switched on, the card must be placed. The unique ID of each RFID card is then read by the reader and is saved in a variable. The reader turns off after the card is read. When the other IR sensor is hit, the read data that is saved in the variable is sent to the system. The data is sent to the system only if the person crosses the other sensor after placing the card else, the buzzer is turned on. Similarly, if the person crosses both the sensors without placing the card, the buzzer is turned on. This makes sure that the person places the card before entering and exiting the room. The workflow of the system is depicted in Figure 3. Hence when a person enters the room, the card must be placed. This ensures the safety of the patients by allowing only the authorized person in a room. In case of any unauthorized entry, that is if an invalid card is placed or a person moves in or out without placing the card the buzzer is turned on. This can be an alert signal for any illegal activity.

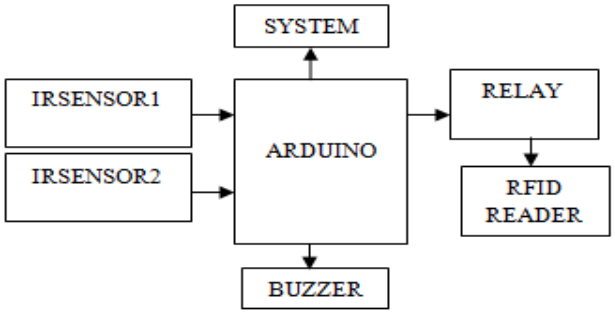

Fig. 1: Hardware Implementation

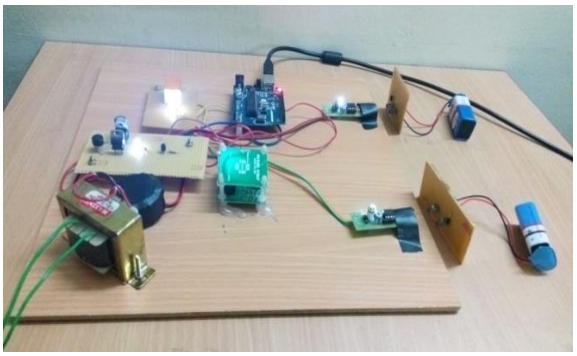

Fig. 2: Snapshot of the setup

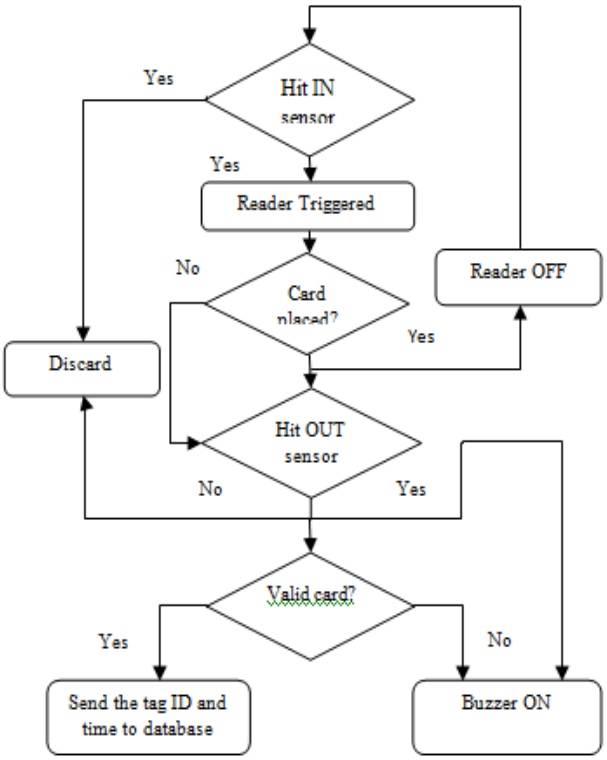

Fig. 3: Workflow Diagram of the System

The hardware connections are shown in Figure 1 and the real time implementation is shown in Figure 2.
The software implementation includes the database for storing the ID details. The permanent staffs of the hospital are provided with a permanent RFID card which they can also use for the purpose of attendance. The details of the permanent staffs are stored in a table while a separate table is maintained for the visitors as shown in Figure 5 and Figure 6. Whenever a card is issued to a visitor, their details are registered along with the time they are permitted to stay in that premise. This makes the card valid only for that particular period preventing the illegal entry using the visitors card.

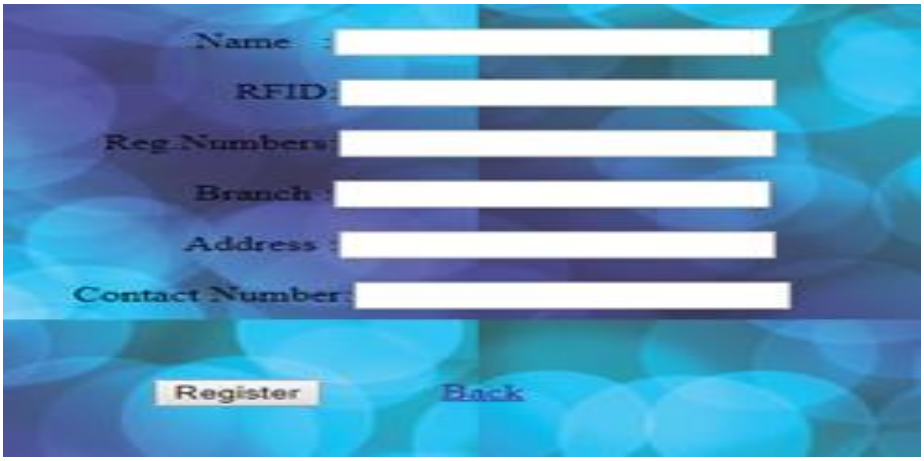

Fig. 4: Visitor Registration Page

A GUI can be created to view the log details of the persons who enter or exit the room and to temporarily register the details of the visitor. Also, the time spent by the visitor can be calculated to ensure that he leaves before the deadline for visiting hour ends. The proposed system can also be used to monitor the access to certain sensitive areas of the hospitals like labs.
The GUI consists of a home page, a page for registration and login page for an admin to monitor the premises. The registration page is shown in Figure 4.

	Staffname	Rfid	intime	outtime	address	contact
	Dr.Atul	58896748	09:00:00	12:00:00	Adayar	9638527410
	Dr.Kumar	12345678	12:00:00	14:00:00	Gilnagar	8960458222
	Dr.Prasad	45678923	14:00:00	16:00:00	Adayar	7856941232
	Dr.Sanjay	55447789	16:00:00	19:00:00	Rknagar	9486759899
	Dr.Ajay	84956231	19:00:00	22:00:00	Rknagar	8945621755
	Dr.Francis	78596245	23:00:00	01:00:00	Rknagar	8599667744
	Dr.Sathya	87958888	01:00:00	04:00:00	Adayar	8659754488

Fig. 5: Database for Storing Staff Details

visitor name	patient name	relation	issued rfid	address	contact	intime	outtime
Ram	Kumar	Father	54897891	Adayar	8596741236	15:00:00	16:00:00
Raj	Akila	Sister	89668745	GN nagar	8796541234	16:00:00	17:00:00
Rakesh	srikanth	Mother	85774522	Gilnagar	9560698988	16:00:00	17:00:00
Akash	Banu	son	25545698	Koyambed	8569858877	15:00:00	16:00:00
Akshay	Sundar	Brother	14935583	Adayar	8599688744	15:00:00	16:00:00

Fig. 6: Database for Storing Visitor Details

4. Results and Discussions

The RFID system provides authentication efficiently and addresses issues regarding privacy and security of patients. The biggest advantage of the system is that the cost is low and easy to use when compared to any biometric system like finger scan, iris scan, etc. and is more efficient than the barcode system. In case of any biometric systems, each visitor's details have to be updated which is more time-consuming, whereas in the proposed system, the registration is done with a click. Also, the same cards can be used again for other visitors. In barcode system while scanning, the

barcodes must be in direct line of sight to the reader for efficient reading and also if it is damaged or ripped off then it is of no use. Also these barcodes can be forged and a duplicate can be made for illegal access. Hence barcodes are less secured than RFID. But there are some loopholes in the system say if a person tries to enter the premise using a card that doesn't belong to him, it cannot be found by the system. The card can only used for entering high threat areas and not for tracking the hospital staffs and visitors. Another disadvantage is that if the RFID tag is lost or stolen, that person must report it as soon as he/she finds the tag missing. To replace the lost tag, another tag can be issued registering that person's details and the lost tag ID can be removed from the database so that it is not misused by any other person.

5. Conclusion

The smart security system provides a better way to authenticate the persons entering the sensitive areas of the hospital. But, the card provided to a particular person can be misused. It ensures that no one can enter the premises without their identity revealed (i.e) at least the cardholder details are known. To overcome this vulnerability, biometric scan like iris scan shall be added. The future scope of the system is that it can be integrated with a GSM module and messages can be sent to the ward's relatives when an illegal entry is made. Similarly, messages can be sent to the manager when illegal access to sensitive premises are made. The RFID system can be used to maintain the details of the patients so that the doctors can easily access them and prescribe the relevant medicines. Also, security can be increased in supply chain management by deploying the technology. Thus the proposed system can be further developed and can be implemented for security purposes.

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