ISSN 2277-3061

RFID Based Efficient Wireless Monitoring System

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ABSTRACT

Nowadays, surveillance has become a need in any private or public area due to the increase in the number of threatssuch as robberies, terrorists, and abusers. In this paper, an efficient wireless monitoring system using Radio Frequency Identity (RFID) is proposed. The aim of this system is to detect a specified target during his movement in the covered region. The efficiency of the proposed system is clearly noticed through both storage capacity and power consuming reduction. This is done by dominating the work of camerasoperation when receiving a signal from the distributed detectors. The obtained results show the saving in power and storage capacity is more efficient in comparison with the traditional monitoring systems. This work has two implemented sides; hardware and simulated environment that using Microsoft visual studio (C# framework).

Keywords

wireless monitoring system, RFID, power consuming, storage capacity.

Council for Innovative Research
Peer Review Research Publishing System
Journal: INTERNATIONAL JOURNAL OF COMPUTERS & TECHNOLOGY
Vol. 15, No. 3
www.ijctonline.com, editorijctonline@gmail.com

1. INTRODUCTION

Recently, monitoring systems play a major role in highly secured areas. The most common monitoring system produces a continuous image and has various problems such as high cost, the need for human intervention continuously, and an inherent difficulty in locating and identifying the intruder because existence of obstacles [1].

The main advantage of wireless connectivity over wire connections is that they support more desirable advantages like accessibility, easy installation, easy enhanced user friendliness, and easy adding new devices to existing networks i.e., expandability[2].RFID is a wireless technology that has been utilized for automated remote identification of objects. An RFID system uses wireless radio communication technology to uniquely identify tagged objects or people. Nowadays, RFID is applied widely in retail stock, supply-chain tracking, management, library book tracking, parking access control, marathon races, airline luggage tracking, toll collection, electronic security keys, theft prevention, and healthcare [3].

The authors of [4] designed an RFID Kids Tracking System to track a moving child in a wide area, such as mall or a park, using RFID technology. This system includes hardware and software components. The hardware architecture contains an RFID active tag, RFID tag reader, web server and database server. The software architecture contains a communication driver that handles all communication functions done in the master station, an Application Programming Interface (API) that handles and analyzes the data, a friendly Graphical User Interface (GUI) and a database that saves all readings and client Information.

In [5], the authors developed an RFID-based e-restaurant system to change the traditional restaurant services which is observed as passive. The utilization of RFID is to improve the service quality which is customer-centered that enable waiters to immediately identify customers via their own RFID-based membership card.

The authors of[6] analyzed the applicability and performance of the Passive Infrared (PIR) sensors for security systems. They proposed a region-based human tracking algorithm with practical implementation and experiment in real environment. From the experiments, the authors find that the human tracking algorithm depend on the PIR sensors performs very well with proper sensor deployment.

In [7], the authors introduced an important implication for monitoring the boarding school students by using RFID technology. Although the project cannot control the punctuation of student but it can ease the workload of school management and save time.

The authors of [7] introduced a context-aware notification system for university students using RFID technology. This system is based on the student's matrix card as the RFID tag (sensor), RFID reader and server as the processors and screen monitor at the different locations in the campus as the actuator of the output.

In [8], the authors proposed a system with RFID and sensor networks to guarantee the keeping quality of low-temperature logistics. The third technology based network and Global Positioning System (GPS) transportations are incorporated to this system to create a full-time monitoring system.

In this paper, an efficient monitoring system has been proposed. The aim of the presented system is to detect the targets within a specific covered area using the RFID technology and then control the operation of monitoring cameras. The proposed system reduces the consumed power and storage capacity by managing the operation of the cameras to be working at specific times.

2. DESIGN OF THE PROPOSED SYSTEM

The design of the proposed monitoring system includes three parts:

2.1 System Description

The designed scheme of the proposed monitoring system is introduced in Figure (1). The proposed building is assumed to contain four cells. Each cell is (5X5) meters and each of which contains two cameras placed in the opposite corners. In addition, each cell is covered by three detectors. The cameras work with the opposite detector to ensure the maximum coverage. The detectors have been configured with range 5 meters, height 2 meters, and beam width 24 degree.

2.2 The Proposed Algorithm

As shown in Figure (2), the proposed algorithm starts with initiating all included components in the covered area to be ready. The detector works on sending signals continuously. Whenever the object has been entered in the covered area, the tag receives the signal from the detector and transmits the related ID to the detector as an acknowledgment signal. After receiving the information from the tag, the command is sent to open camera. The detector has been assumed to send the information of the underlying tag combined by picture or video stream to the control center through wireless technology. The proposed algorithm calculates the power consumption and storage saving.

ISSN 2277-3061

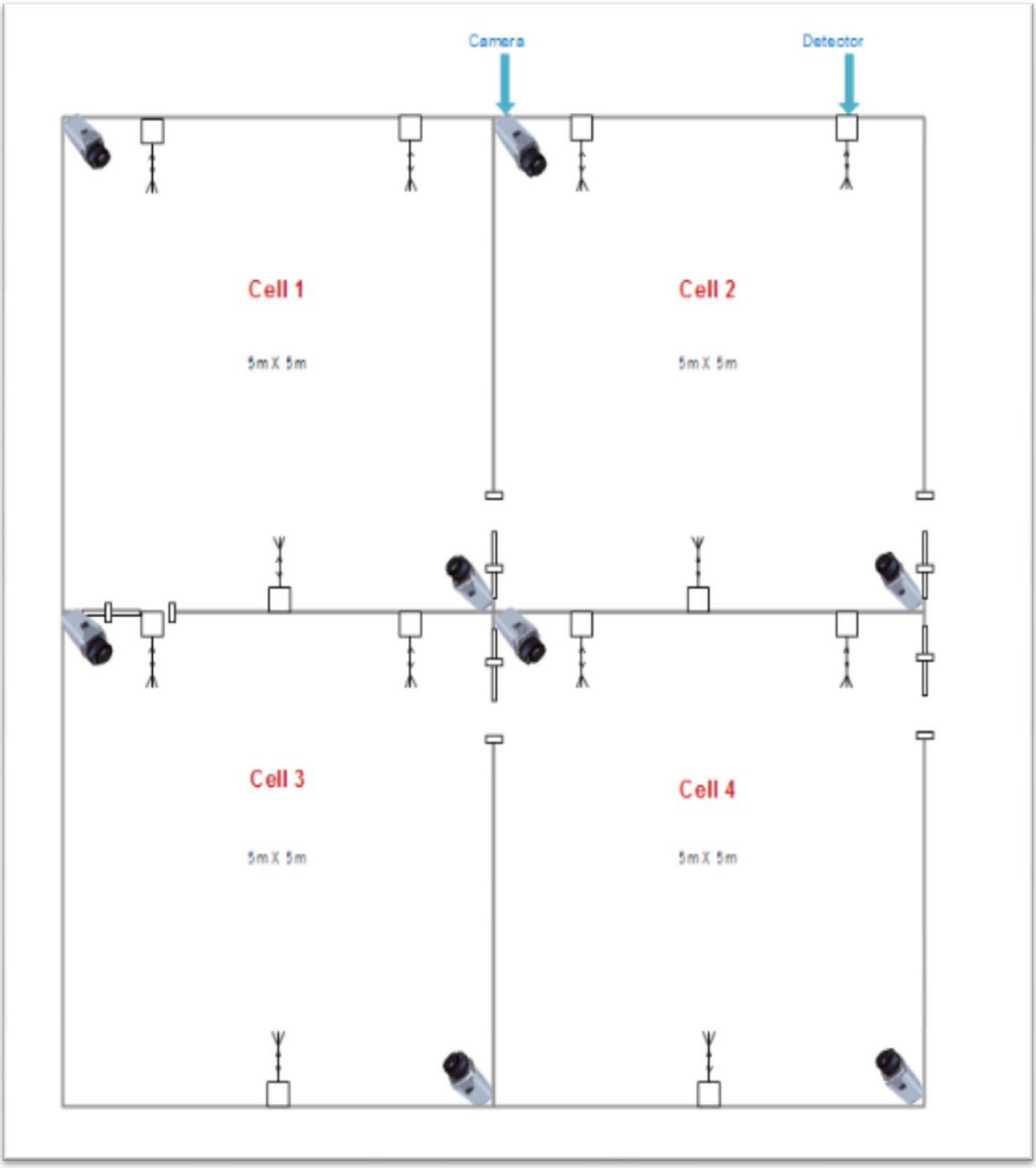


Figure (1) System Diagram

2.3 Software Selection

Choosing the software to implement the proposed algorithm is an important issue. The proposed system contains numerous graphics and movements as well as many calculations must be implemented during the system operation which requires software that supporting this side. Therefore, Microsoft Visual Studio is selecteddue to the included featuresandcharacteristics.

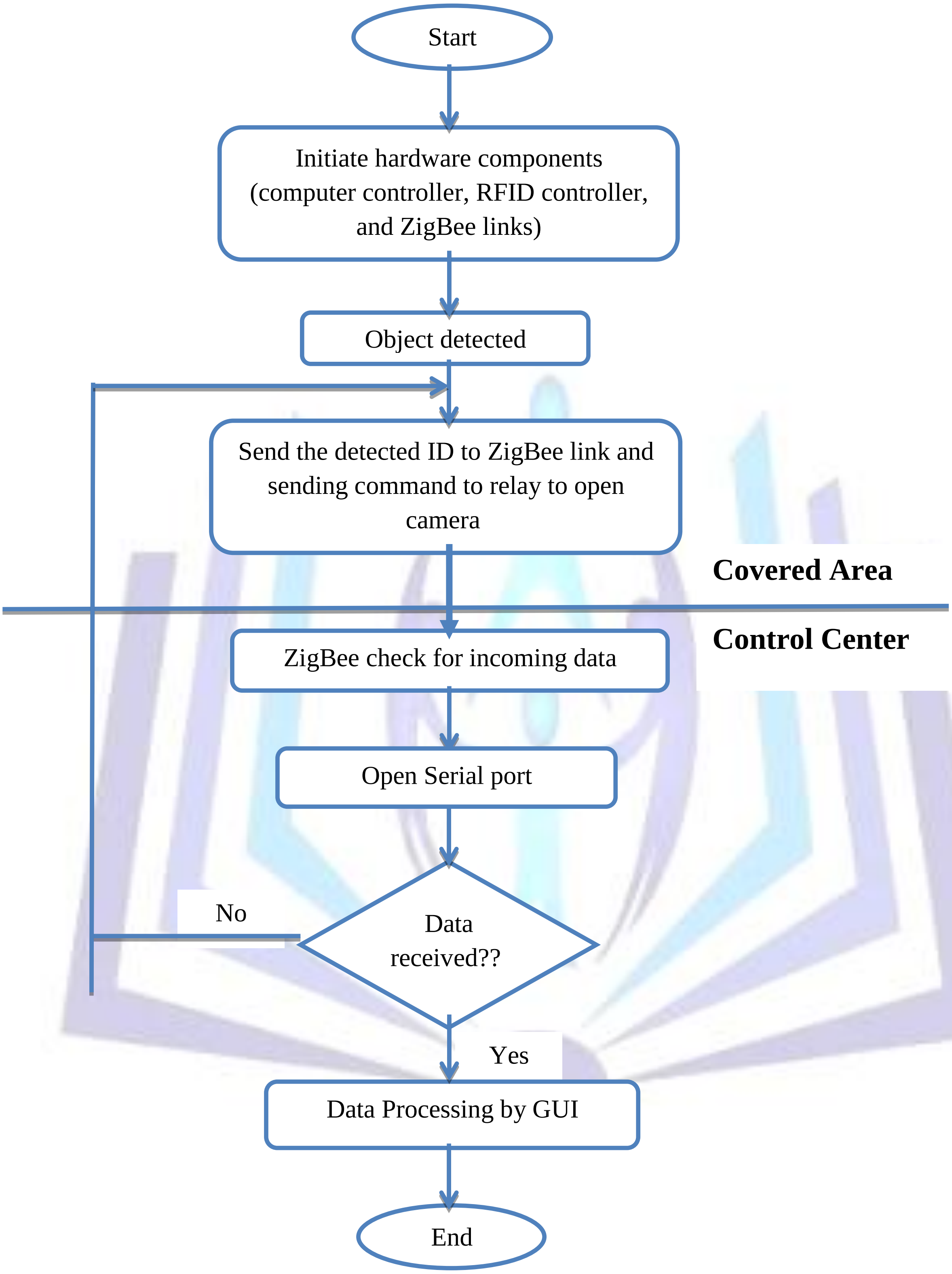


Figure (2) The Proposed Algorithm

3. SIMULATION SETUP

The monitoring system consists of different challenges, such as power consuming, cost, and storage capacity. The proposed monitoring system is designed, as shown in Figure (1), to work at low power consuming and small storage capacity in comparison with the conventional monitoring system as well as tracking tasks.

The simulation environment that designs the monitoring scheme has been built in Microsoft visual studio. The operation power of each camera is assumed to be 10 wattand the storage capacity is assumed to be 270 Mbyte/hour [10].The cameras considerbeing idle in this system, at the time of no detection for any subject. Therefore, the cameras will turn on whenever the object is detected.

The General User Interface (GUI) of proposed system contains the main window as shown in Figure (3). Whenever the target is being inside the cell and has been detected, the system automatically calculates the power consuming and storage capacity as shown in the field of (power consumed and storage) in this figure. The name and ID of the detected target is appeared in the Detected and Target fields.

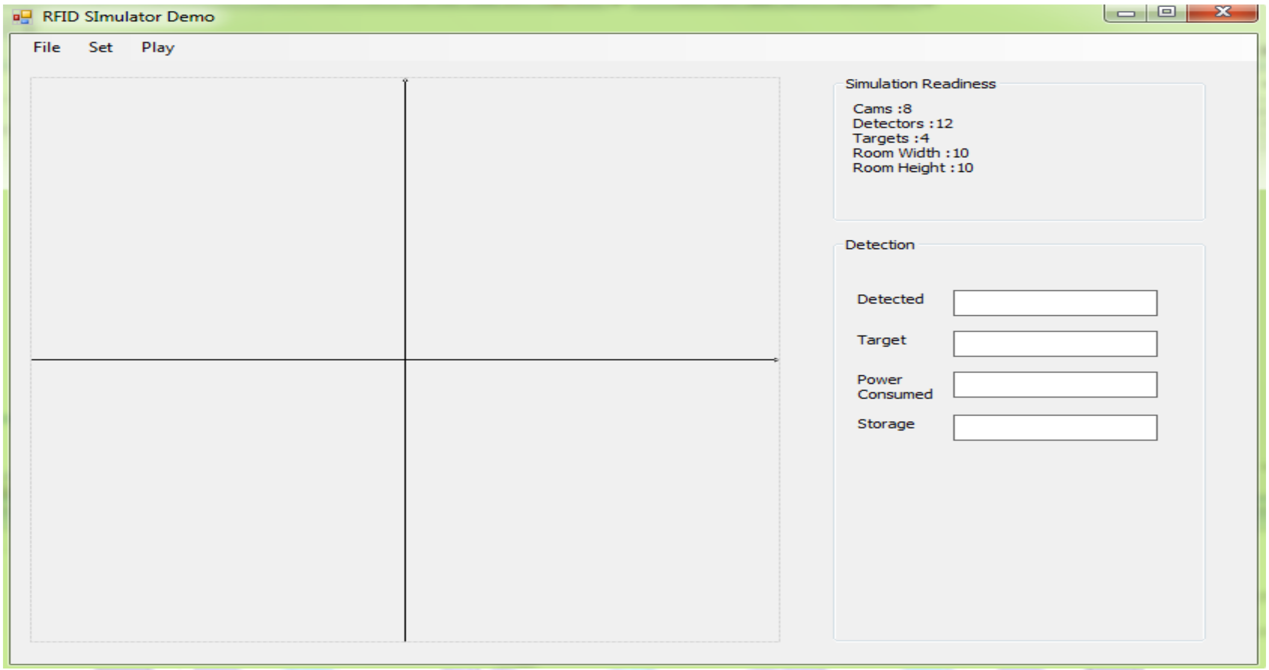


Figure (3) GUI of the Proposed System

The main window of the GUI contains many functions, such as (FILE, Set, and Play). The first menu item is FILE which contains the exit option, the second menu item is play to start and pause the simulation. Additionally, the third menu item is SET which contains many settings of the simulation listed below:

*Targets:*As shown in Figure (4), the target can be added, updated and deleted. After adding the target, the simulation program generates unique ID and code for each target, and then sets the target name, starting point of movement and setting the path. Update can change the path, name and position of starting target movement, while Delete button removes the target from the simulation.

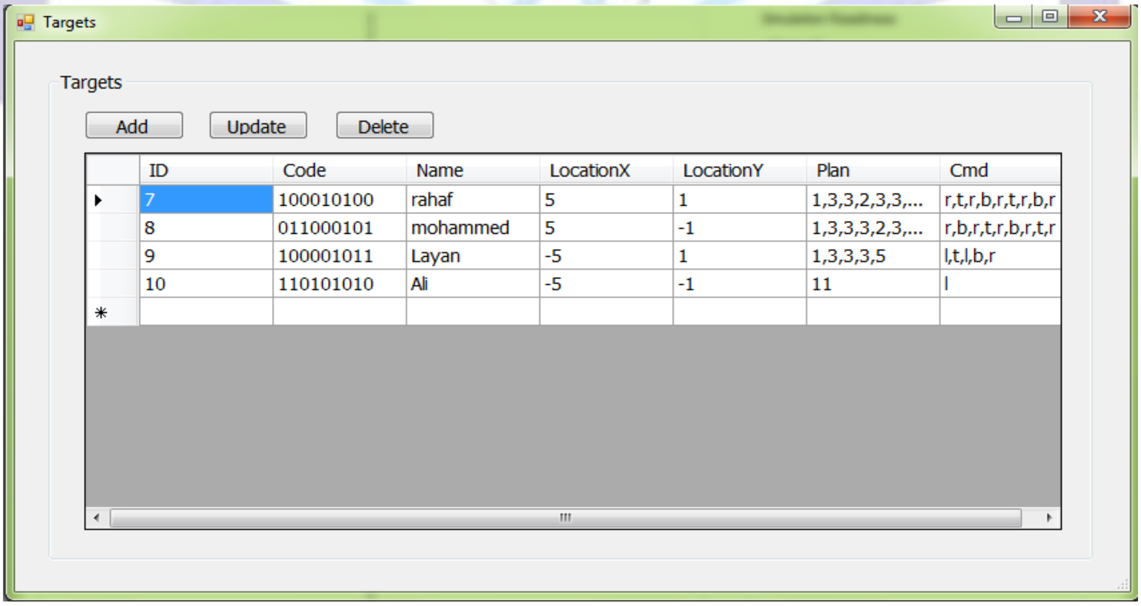
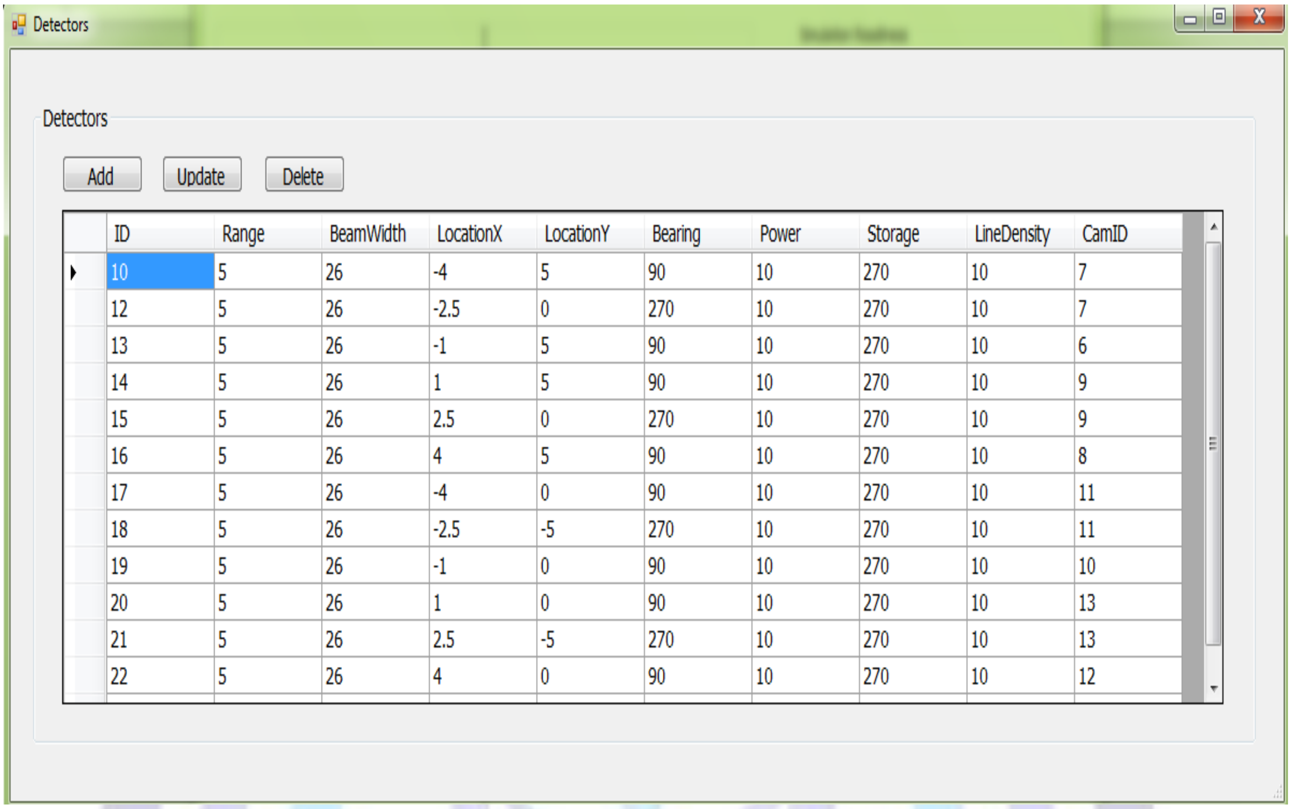


Figure (4) Target Setting Window

Detectors: this window used for adding, deleting, or updating the detectors settings, as shown in Figure (5). When adding a new detector, we must enter its specifications which are the range of covering, beam width, the location of the detector, bearing of antenna in degrees, power consumed and storage when target enters the area, and with which camera that detector will work as shown in Figure (6).



ID	Range	BeamWidth	LocationX	LocationY	Bearing	Power	Storage	LineDensity	CamID
10	5	26	-4	5	90	10	270	10	7
12	5	26	-2.5	0	270	10	270	10	7
13	5	26	-1	5	90	10	270	10	6
14	5	26	1	5	90	10	270	10	9
15	5	26	2.5	0	270	10	270	10	9
16	5	26	4	5	90	10	270	10	8
17	5	26	-4	0	90	10	270	10	11
18	5	26	-2.5	-5	270	10	270	10	11
19	5	26	-1	0	90	10	270	10	10
20	5	26	1	0	90	10	270	10	13
21	5	26	2.5	-5	270	10	270	10	13
22	5	26	4	0	90	10	270	10	12

Figure (5) Detector Setting Window

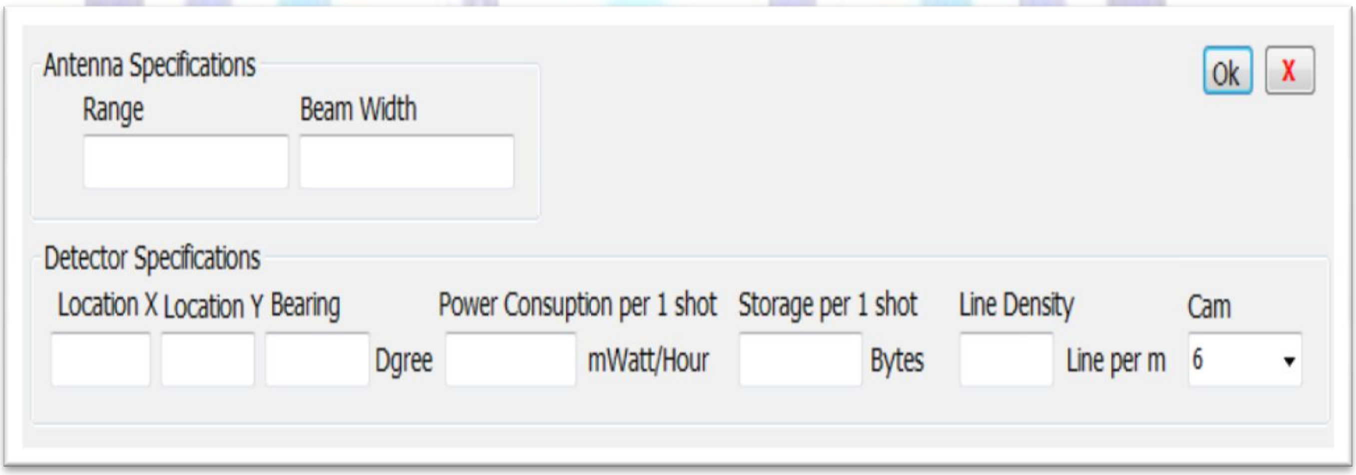


Figure (6) Adding Detector Window

Cams: the Cams window can be used for the setting of cameras in terms of adding, deleting and updating actions, as shown in Figure (7). When adding a camera, we must specify its location. The simulation automatically links the detector with camera as defined in detectors window.

Room: the dimensions of room are set, as shown in Figure (8).

ISSN 2277-3061

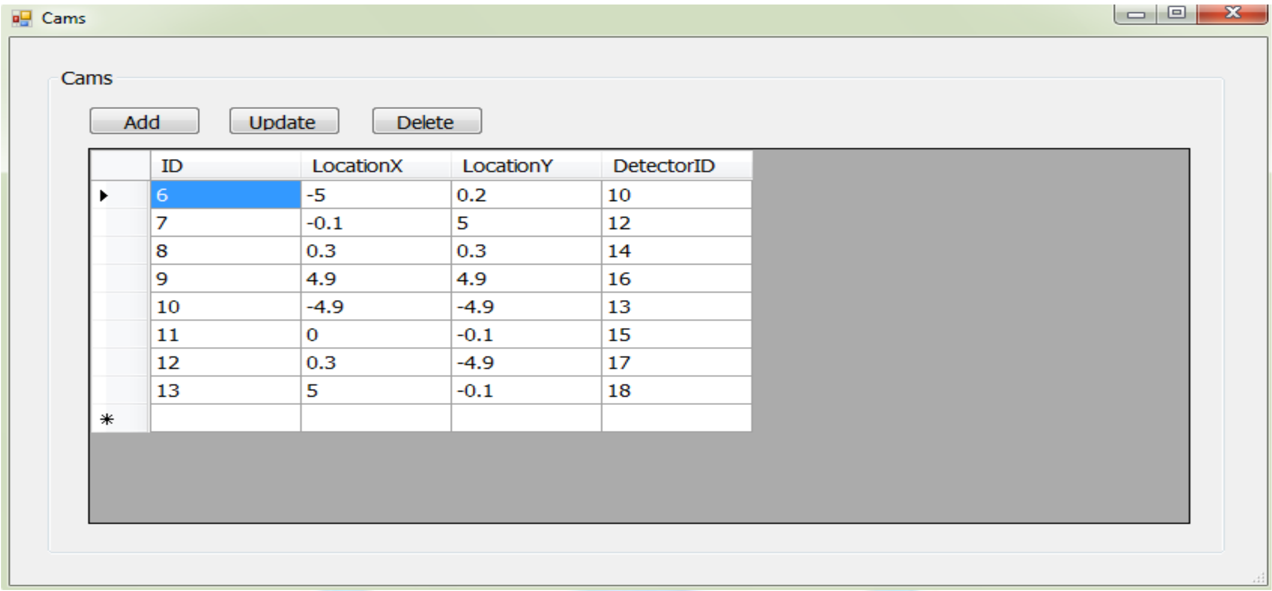


Figure (7) Cameras setting

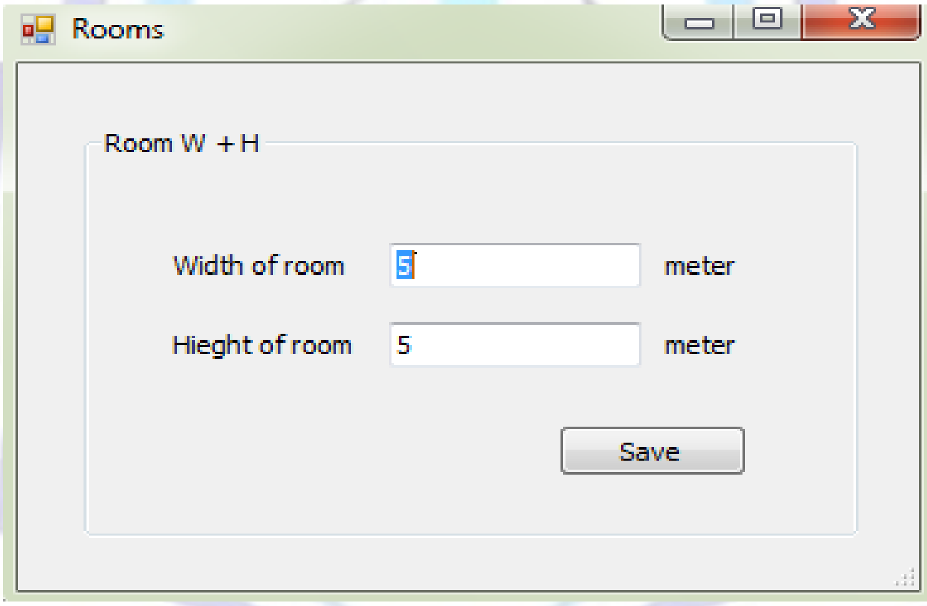


Figure (8) Room Dimension Setting

The power consumption is calculated according to equation (1)

$$\mathbf{P_{ct} = N \times P_c} \quad \ldots(\mathbf{1})$$

Where P_{ct} is the total consumed power, N is the number of cameras in operation and Pc refers to consumed power of each camera.On the other direction, the memory consumption is calculated according to equation (2)

$$\mathbf{M_{ct} = N \times M_c} \quad \ldots(\mathbf{2})$$

Where M_{ct} is total consumed memory storage, N refers to number of cameras in operation and Mc is the consumed memory storage of each camera.

4. WORKING SCENARIO

In order to test the proposed system, a working scenario has been assumed. In this scenario, four objects enter the building (covered area) and move between the cells from different entries as shown in Figure (9).This scenario is designed based on random paths that the four objects can choose to move inside each cell. This is to ensure that all cameras are turned on. Figure (10) shows the operation of cameras and detectors in each cell of the proposed system for this scenario.Two tables have been considered. Table (1) describes the consumedand saved power in this scenario. Table (2) describes the storage capacity.

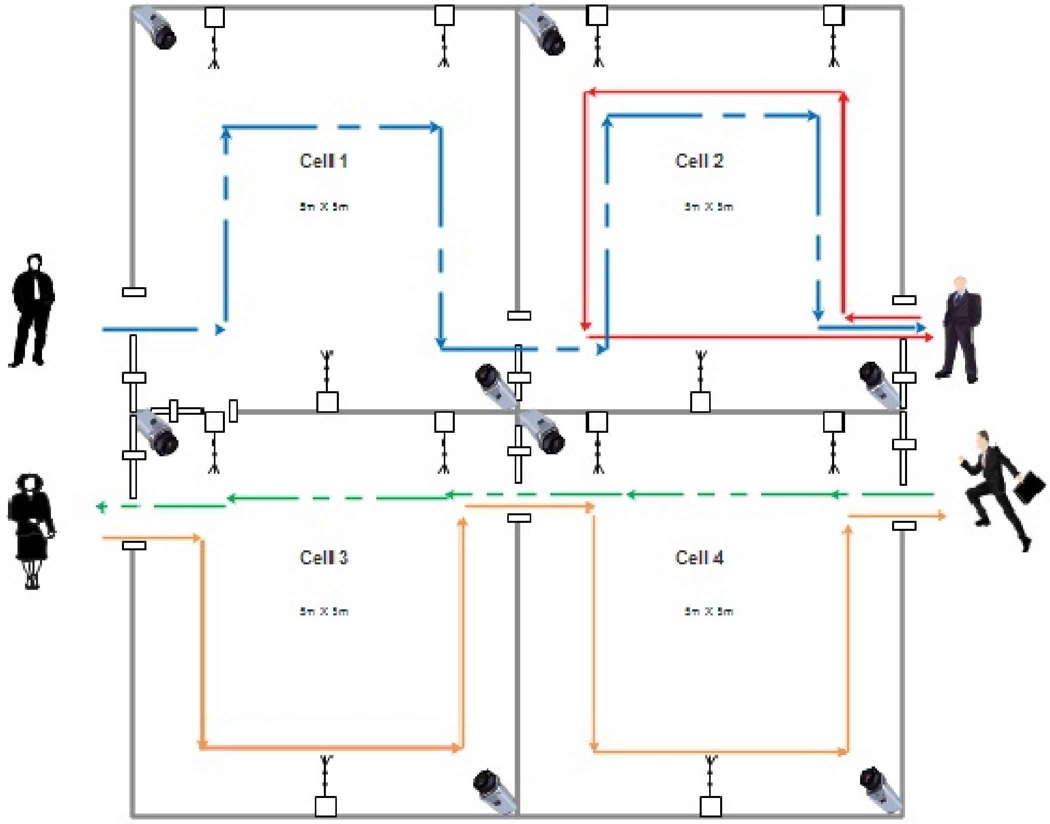


Figure (9) Working Scenario Representation

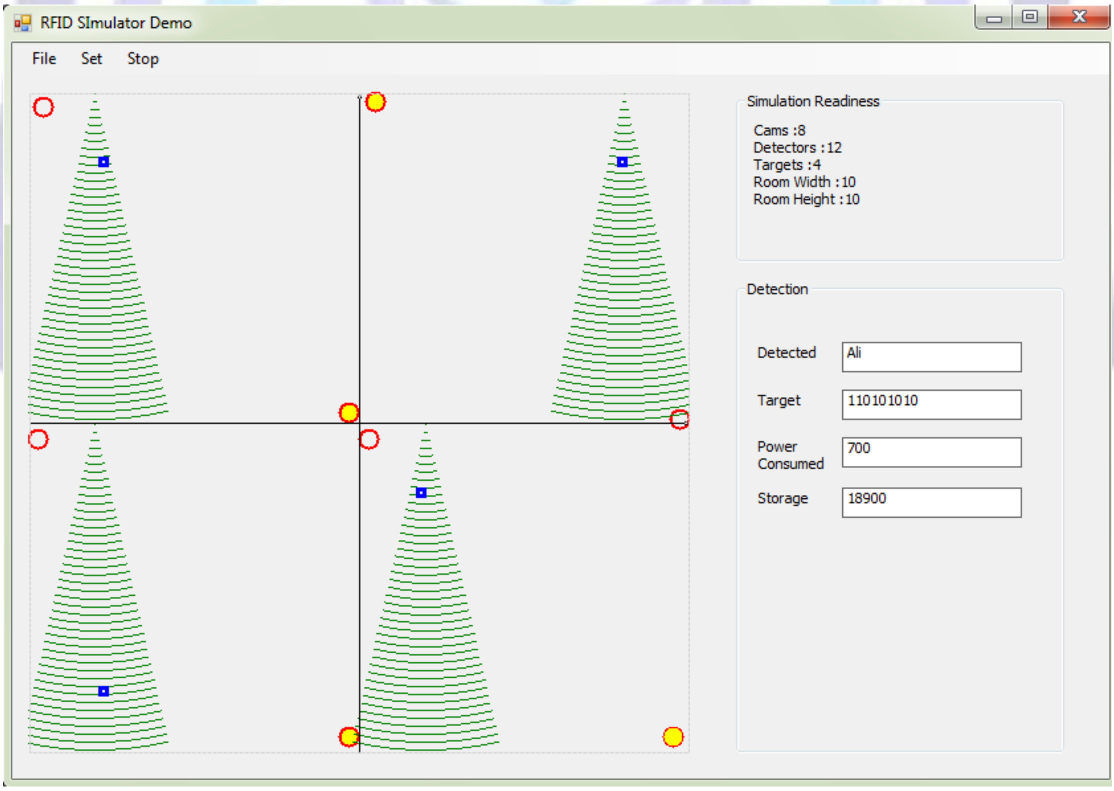


Figure (10) Simulation of scenario

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It is noted from the above tables the amount of saving in consumed power and capacity storage of the proposed system in comparison with the traditional systems. In addition, these tables prove the efficiency of the proposed system. This is in terms of covered area and operation of object detection as well as the saving in power and storage capacity consumed.

TABLE (1) POWER CONSUMPTION

	Number of working cameras		Power Consumed in watt		
Step	Proposed system	Old system	Proposed system	old system	Power Saved
1	4	8	40	80	40
2	4	8	40	80	40
3	4	8	40	80	40
4	4	8	40	80	40
5	4	8	40	80	40
6	3	8	30	80	50
7	3	8	30	80	50
8	4	8	40	80	40
9	4	8	40	80	40
10	4	8	40	80	40
11	3	8	30	80	50
12	3	8	30	80	50
13	3	8	30	80	50
14	3	8	30	80	50
15	2	8	20	80	60
16	2	8	20	80	20
17	2	8	20	80	20
18	2	8	20	80	20
19	2	8	20	80	20
20	2	8	20	80	20
21	2	8	20	80	20
22	2	8	20	80	20
Total power			660	1760	1100

TABLE (2) STORAGE CAPACITY

	Number of working cameras		Storage in M Byte		
Step	proposed system	old system	proposed system	old system	Storage saved
1	4	8	1080	2160	1080
2	4	8	1080	2160	1080
3	4	8	1080	2160	1080
4	4	8	1080	2160	1080
5	4	8	1080	2160	1080
6	3	8	810	2160	1350
7	3	8	810	2160	1350
8	4	8	1080	2160	1080
9	4	8	1080	2160	1080
10	4	8	1080	2160	1080
11	3	8	810	2160	1350
12	3	8	810	2160	1350
13	3	8	810	2160	1350
14	3	8	810	2160	1350
15	2	8	540	2160	1620
16	2	8	540	2160	1620
17	2	8	540	2160	1620
18	2	8	540	2160	1620
19	2	8	540	2160	1620
20	2	8	540	2160	1620
21	2	8	540	2160	1620
22	2	8	540	2160	1890
Total Storage			17820	47520	29700

5. CONCLUSION

A RIFD based monitoring system for a specific object has been proposed. The proposed system adopts the RFID technology to detect the underlying objects. In addition, the covered area sent the detection information to the control center for analyzing and processing. The feedback decision sent from the control center is to control the operation of cameras. The proposed system has been tested in the simulation environment as a working scenario. Based on the obtained results, the proposed system outperformed the traditional systems efficiently in terms of the consumed power and storage capacity. The percentage of enhancement for the proposed system compared to existed system is 62.5%.

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