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Research Paper

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Design of Wireless Sensor System of Monitoring and Controlling Parking Cars

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Abstract— Recently advanced electronics technologies have been widely used in many applications to provide efficient services. Modern cities are becoming more crowded with cars due to the civilized life of people; so there was shortage of the available parking places. Thus to overcome this problem, the available parking spaces must be organized using sophisticated system to avoid many problems such as illegal parking, accidents, waste of fuel and time. The objective of this paper is to design a smart parking system to help drivers easily parking their cars in crowded cities. The design used a network of infrared sensors that sensed the situation in each space of the parking. The design structure consists of group of sensors, XBee module and Arduino microcontroller. The devices are connected wirelessly to a monitoring page through an XBee transmitter. The monitoring page displays the parking availability the crowded places and parking time. As soon as the vehicle been in the correct position the timer begins to display on the monitoring page. The system users have a username and password to access the monitoring page. The system simulated in different operating scenarios in order to overcome all the problems of parking. The results give that the system works correctly and achieved the required objectives .The simulation results reveal that the proposed system can be an excellent solution to many parking problems for the government facilities and other large facilities.

Keywords— Electronic design; Sensors; WSN; Visual basic

I. INTRODUCTION

The difficulties of the illegal parking of cars appeared since the number of vehicles were increased all over the world and becomes widely noticed with the expansion of population and the developing of societies[1].Some studies have shown that in every week; about three thousands of new cars are added in big cities such as Mumbai and Delhi,therefore the parking design structure becomes very important and has been demanded in the urban area [2]. The problems and solution of parking cars is differing from place to another. The design of smart parking systems improved the transportation traffic efficiency of vehicles from entry to the specific parking places[3]. In general parking system is either to be public which available to all cars in street or it may be private parking which used by special facility [4].The most problems that a smart parking system has to overcome over a traditional system is the loss of time while searching for an empty place, as well as the waste fuel during this process in addition to the accidents that may occur due to the large number of veciles moving in it [5].The goal of this paper to develop efficient maneging system of parking cars using modern technogy.There are many contributions that can be found in this paper, it push the country economic forward by saving the time,thus adding more working hours also it contributes in supporting the human health due to decreasing the amount of the CO_2 gas. The paper describes an arduino design that used in managing parking system by controlling the entrance and monitoring the free spaces. The arduino board is advanced control tool helps computers to sense and control the physical objects in the specific environment[6]. Many versions of arduino existed in the market , arduino Mega was used in this paper because it contains 54 digital inputs and outputs that can be used in the control system and its archetecture based on ATmega2560 microcontroller[7][8]. The system connected wirelessly to the monitor page which designed using the visual basic language. This page used to monitor the traffic in the parking wirelssly and it was secured by using username and password. The wireless sensor networks is used in various applications to monitor and control objects wirelessly in a specifec environment [9]. The structre and algorithm are discussed in the rest sections of the paper.

There are many of researches published recently that attempts to develop an efficient technology for parking system, There are many differences in terms of the operation mechanism, structure and the management features , most of those published papers were used only to help drivers to find the right place. The published papers also differ in the types of sensors and monitoring system.

The significant of the proposed system because of the simplicity of structure and operation which is important issue for undeveloped countries and can be used for general parking in large cities or in internal parking of the government facilities. The proposed system provides real time information of the free spaces in the parking and counts the time that the vehicle spends in the parking. The system used the wireless technology to obtain real time managing of the parking status.

II. RELATED WORKS

Yamani et al [10] presented a review of smart parking systems and discussed the most technologies that used in implementing smart parking. The paper of Sarma [11] overviewed some of the wireless parking systems and discussed their structures and advantages. Moon [12] explained a design of wireless sensor network which used to specify the free space in the parking, the sensors transmit their data through radio frequency (RF) link. The design in Shambwani et al[13] based on the Microcontroller AT89S51,it represents a monitoring system of the parking car and it did not includes wireless connection or specified monitoring page in used LCD unit to display the status and the position of the car. The monitoring system in Saif [14] also focused on specified the free places and used wireless sensor network to send the received data wirelessly. The paper concludes that its design is low cost and friendly in the use. Kharde et al [15] survey different parking and monitoring systems the paper discussed them economically. The system in Rahman [5] also used to help drivers to find the free parking space a website used to view the spaces in the parking. Ahmed [16] discussed in his paper the parking problems in the city and defined the causes of this problem and explained how modern technology can give solution to this problem. Natarajan [17] used Lab View software to implement smart parking system which used to find the empty area in the parking and it used display unit without using wireless technology. Luque et al [18] used ultrasonic sensor to show the status of the parking, the system was connected using internet, to display the free spaces of the parking

III. METHODOLOGY

The proposed parking system design model considered four places in addition to the entrance gate as shown in Fig.1.

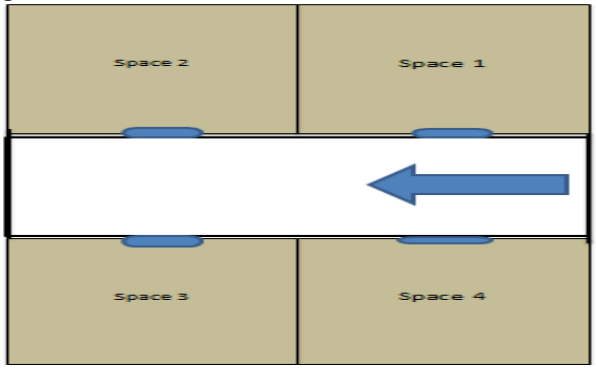

Figure.1: Parking plan

The block diagram of the proposed system is shown in Fig.2.It consists of the following five sections:

- Control unit: this unit represents the heart of the system as it processes all the received data.
- Display unit: the obtained data can be displayed in the LCD module and also wirelessly in the monitoring page as well as the virtual screen in the protuos environment.
- Actuators: this used to control the main gate of the parking.
- Transmitter: this unit used to connect the hardware and the monitor page wirelessly.
- Sensors: responsible to sense the instance status of each parking spot.

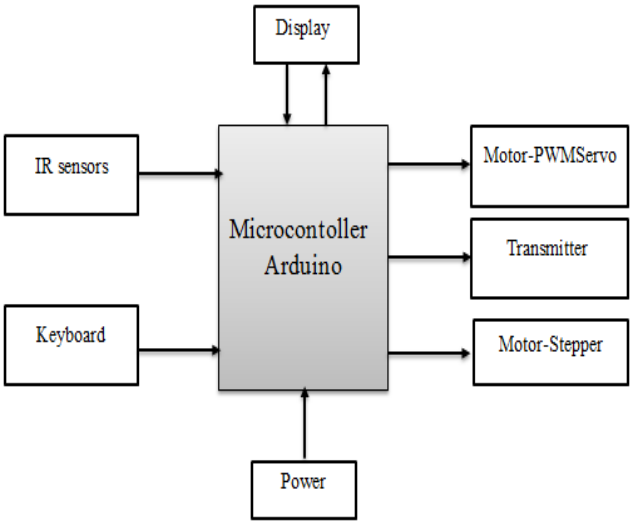

Figure.2: Block diagram

The electronic circuit as shown in Fig.3 contains two XBee modules, one of which is used to transmit collection data from the sensors to the monitoring page while the other is used to the receiver on the other side of the circuit.

The keypad is placed at the entrance gate; it used to enter the security information which required to open the gate. Only the correct security information will allow the gate to be opened. The LCD screen in the main gate displays the available parking spots.

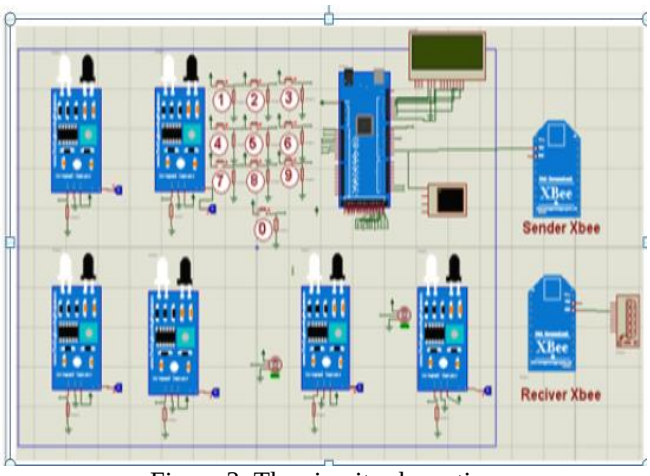

Figure.3: The circuit schematic

Any parking space includes two infrared sensors that are used to monitor the movement of the vehicle in the parking place which either incoming or outcoming. The infrared sensor consists of light emitting diode works as transmitter and photodiode works as receiver, the operating of this sensor depends on the received the transmitted wavelength, the resister and the voltage of the sensor changes according to the amount of the received radiation [19]. The timer counts the parking time once the vehicle been stopped in the parking place up to the moment where the car exists. The transmitter unit connected to Arduino sends this information to be displayed in the monitoring page. The receiver structure as shown in Fig.4 consists of XBee unit connected to the virtual serial communication module.

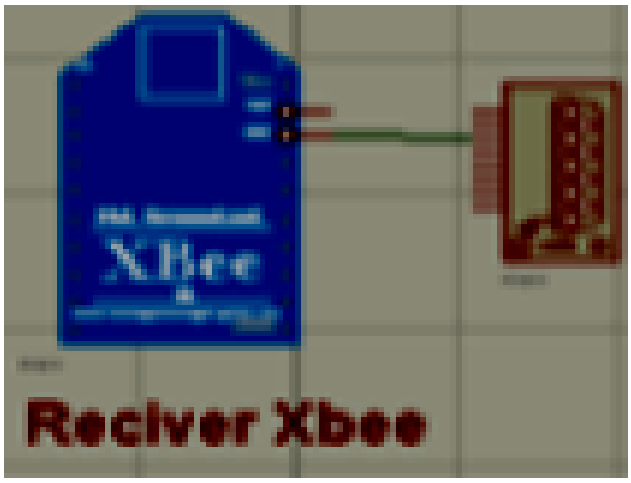

Figure.4: Receiver circuit

The keypad shown in Fig.5 was placed at the parking system entrance gate and is used to enter the required password and username.

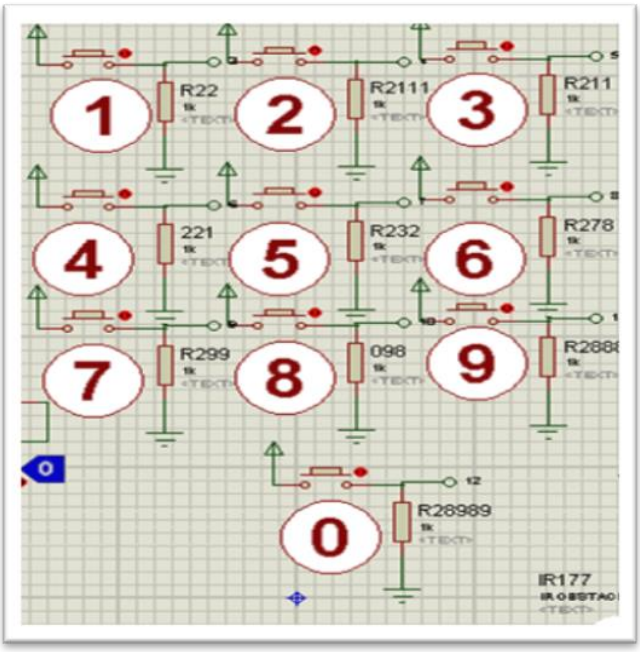

Figure.5: Keypad

It consists of programmable switch matrix which is read by the input /output of the microcontroller. The switches arranged in matrix form of rows and column.

IV. SOFTWARE ALGORITHM

The operating algorithm of the smart parking system is shown in Fig.6. As shown this is a real time design which gives continuous reading. The first step in the operating algorithm is to enter the correct password then receive the sensors measurements, if it was correct then the gate will open and as soon as the car enters the free zone the timer will start to count the time.

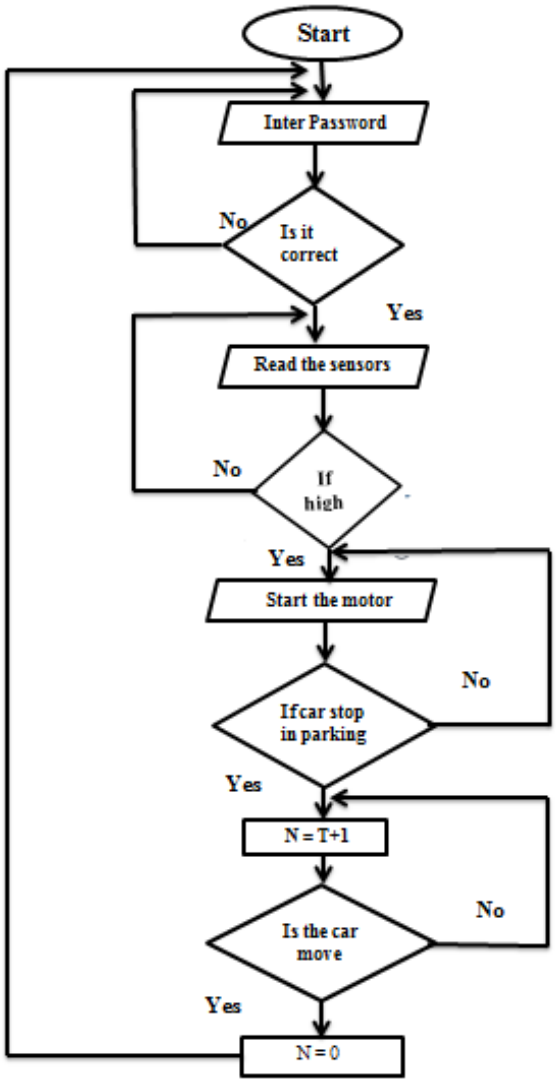

Figure.6: Algorithm

V. MONITORING SYSTEM

The monitoring interface page is designed by using the Visual Basic language and the first interface page is shown in Fig.7. it is used for security purposes, this page is the first step in operating the proposed parking management system and it is used to enter the correct password and username.

Figure.7. Security page

If the username and password match the correct reference data then a success message will appear as shown in Fig.8, so the user will be able to access to the main monitoring screen as shown in Fig.9.

Figure.8: Successful massage

The main screen will directly display the receiving data from the sensors environment once the user selects the connection button on the upper right corner of the main screen.

Figure.9. Main screen

VI. RESULTS AND DISCUSIONS

Three scenarios were assumed in testing the system, the full empty case, complete full case and the case of both empty and a part occupied. The simulation aimed to ensure that system works correctly in all those situations.

- Case 1: In this case the parking is completely available as all the parking spaces were available therefore all the sensors are reading zero value. This case shows that the parking able to receive visitors and the timer displayed zero values as shown in Fig.10 .

- Case 2: In this case the parking is completely full, therefore all the sensors sense that cars have entered as shown in Fig.11, all the gates in this case are closed and the time counter begins to show the parking time.

- Case 3: In this case as shown in Fig.12 some parking spaces become available again, thus the corresponded sensors are reading zero values and the timer adjusted to the zero referring to the new state.

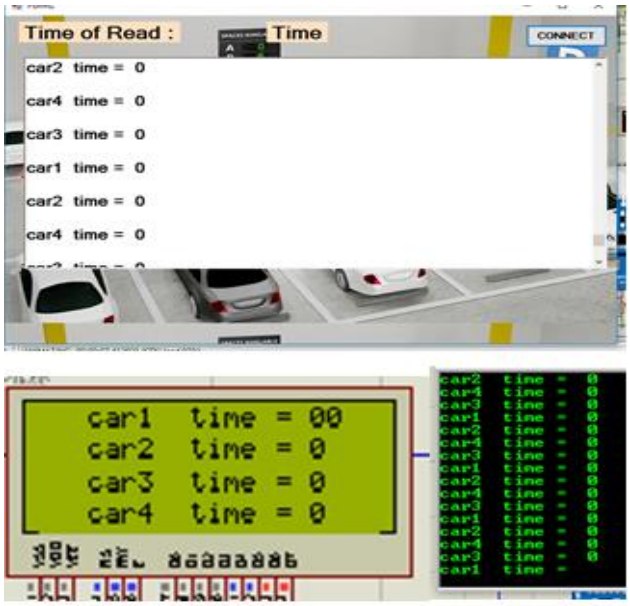

Figure.10: Case 1

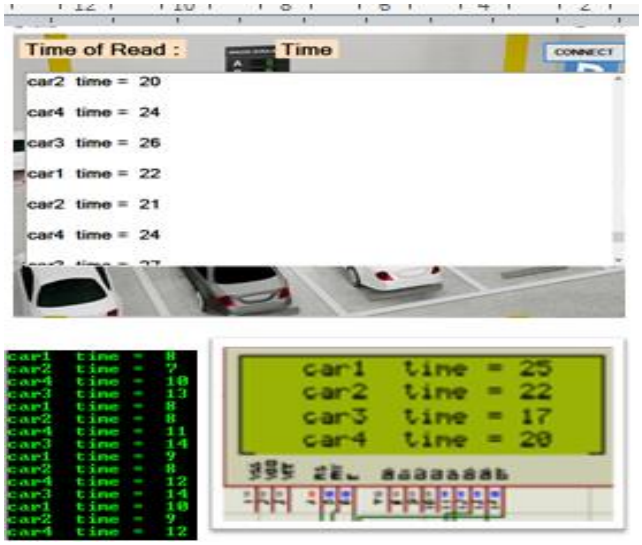

Figure.11: Case 2

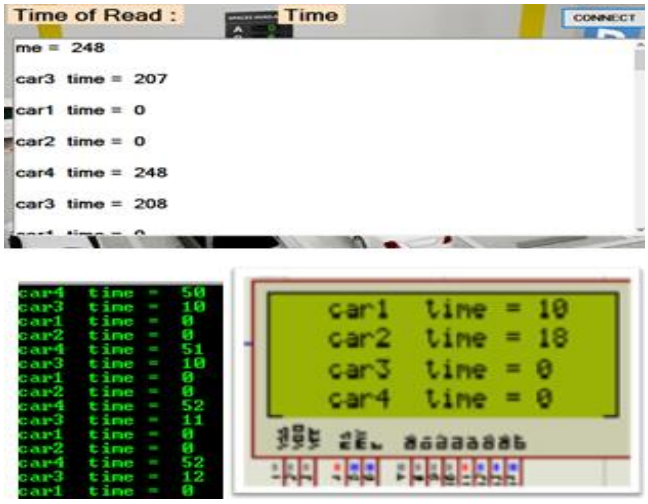

Figure.12: Case 3

The overall results were correct and reveal that the system provides excellent service, the empty place displays zero time in the LCD, virtual terminal and the monitoring page. The full place in the parking shows a value in the time counter refers to the time that the vehicle used the free space in the parking.

VII. CONCLUSION AND FUTURE SCOPE

This paper proposed a smart parking system which aims to increase the efficiency of using the available places for parking cars. The paper was significant by using simple monitoring program that offers ease use of most drivers. The system was managed wirelessly by using wireless connection device. The system was secured by using a password to login into the monitoring page also password required to open the parking gate. The results obtained by testing the parking smart system in three situations. The overall results were correct and proved that the system is reliable and provides efficient service. The system count the time that the vehicle took in the parking, when the time in the monitoring page was zero that means there is available space it. This system is helpful in developing cities and managing space as the required objectives. For future the system can add more services such as smart paying.

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REFERENCES

[1] An Overview Of Common Parking Issues, Parking Management Options, and Creative Solutions" Prepared For: City of Pasadena Department Of Transportation , Banerjee & Associates"**2003**

[2] Kimly H" *Parking Structure Design Guide Lines*", prepared for capital city BIOS E IDAHO, **2016**.

[3] Zhendong Liu, Dongyan Li, Yurong Yang, Xi Chen, Xinrong Lv, and Xiaofeng Li," Design and Implementation of the Optimization Algorithm in the Layout of Parking Lot Guidance", *Wireless communication and computing*,,Volume. 2021, Article ID 6639558, 6 pages, 2021. https://doi.org/10.1155/2021/6639558.

[4] Ching-Hung Lee, Yu-Hui Wang, Amy J.C. Trappey, Service design for intelligent parking based on theory of inventive problem solving and service blueprint, *Advanced Engineering Informatics*, **Volume 29, Issue 3, Pages 295-306, 2015,** ISSN 1474-0346,

[5] Saidur Rahman, Poly Bhoumik" IoT Based Smart Parking System", pp. 11–16, International Journal of Advances in Computer and Electronics Engineering, **Volume 4, Issue 1, January 2019,** ISSN: 2456 – 3935

[6] Kimmo Karvinen and Tero Karvinen" *Getting started with sensors*", Maker media, **2014**.

[7] Charless B," *Beginning Sensor Networks with XBee, Raspberry pi and Arduin"*, second edition, Apress, **2020**

[8] John . B *" Arduino Workshop*", no starch press, **2013**.

[9] K. Sohrabyn. D. Minoli, T. Znati. , "Wireless Sensor Networksp", **2007**.

[10] MY Idna Idris, YY Leng, EM Tamil, NM Noor, Z Razak " Car park system: A review of smart parking system and its technology *", Information Technology Journal* **Vol(8) issue (2): pp:101-113, 2009**

[11] G.Revathi and V.R.Sarma Dhulipala ," Smart Parking Systems and Sensor "In the proceeding of the 2012 IEEE *International Conference on Computing Communication and Applications 1(ICCCA2012*), Tamilnadu, **pp:1-5, 2012.**

[12] Jung-Ho Moon, Tae Kwon Ha " A Car Parking Monitoring System Using Wireless Sensor Networks" *World Academy of Science, Engineering and Technology International Journal of Electrical, Computer, Energetic, Electronic and Communication Engineering* **Vol:7, No:10, 2013.**

[13] Harsh Shambwani, Pawan Ailani, Vishal Janyani " Intelligent Car Parking Monitoring System ", *International Journal of Science, Engineering and Technology Research* (IJSETR), **Volume 4, Issue 9, September 2015**

[14] Humaid Saif Alshamsi, Veton Z Këpuska"Smart Car Parking System" *International Journal of Science and Technology*, **Volume 5 No. 8, August, 2016.**

[15] Prasad Kharde, Sujeet Pal, Santosh Kawle "Smart Parking System" *International Journal of Scientific Research in Computer Science, Engineering and Information Technology* (IJSRCSEIT), **Vol.(3) issue(1), 2018,** ISSN : 2456-3307

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