Low Cost and Simple Management and Security System for Hospitals and Hotels

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Abstract
In this paper we designed and built an automatic parking lot management system that keeps track of vehicles entering and leaving a parking lot. Another system was designed and built to record (using a camera) activities of cars entering and leaving the parking lot. Secondly we designed and built an automatic service request management system. This system keeps track of all requests from different rooms and keeps a record of them. Thirdly we designed and built an automatic phone call management system that utilizes the existing power lines as the phone call carrier medium. For all systems we developed programs and employ a visual interface design.

I. INTRODUCTION

1.1 Parking Lot Management and Security System

With all events taking place around the world, security concerns are continuously on the rise. As a consequence of wars, conflicts, or social problems, security concerns must be thoroughly evaluated and necessary measures must be taken in order to reduce risks and improve the safety of people, assets, and facilities. Many places need to be kept secure from intruders or suspects. Parking Lots are provided for visitors of all government buildings, hotels, hospitals, and large buildings. They have been a prime security concern, as many incidents of terrorism were carried out by implanting cars with bombs in parking lots of important buildings. Management and security of parking lots is a continuous challenge. It would be a great idea if an automatic management and security system is designed to continuously manage and watch a parking lot .Cameras are utilized extensively for security solutions. Due to technological advances in manufacturing, cameras are very affordable, abundant, and being used nowadays to monitor and record all activities within certain places. For example banks, airports, government facilities, and even supermarkets are equipped with different cameras that keep recording and tracking activities inside and outside those facilities.

Normally, a camera and a video recording system is installed at the gate of the building to take photographs or a slow motion video and record them along with a timing stamp which tells the reviewer of these records the time and date information. Such systems will allow retrieving the photographs taken within a defined period of time A draw back is that current security systems employ cameras that keep running and recording continuously regardless of activity taking place or not. Such practice produces huge amount of recorded data and requires huge storage capacity especially when high resolution cameras are used. As a result the captured data quickly fills the storage devices being used. [1]

1.2 Service Request Management

Modern hospitals and hotels are of great importance for nowadays civilized communities. Hospitals extend their medical services to all people, adults and children. Hotels extend their services to most travelers from within the country or from outside the country. Millions of people use the services of hotels and hospitals throughout the world daily. Modern hospitals and hotels of nowadays have high tech equipments that are used for many different purposes. These equipments integrate advanced electronics and computer systems to provide extremely useful tools. Nurses in hospitals continuously watch patients that stay at different rooms. These patients require some assistance at certain times. The on duty nurse is supposed to answer the requests from different patients and address their demands or concerns. Similarly in hotels many rooms are occupied by hundreds of guests daily. These guests have different demands that need to be answered in order to keep the service quality of the hotel at a higher class. Current service request management systems located at hospitals produce an audio and a visual alarm at the nurse desk indicating that requests have been issued. The nurse should keep track manually of the requests. Work stress can cause the nurse to miss some of the requests or answer some requests before others. Similarly in hotels requests are in general placed by the guests via telephone. The help desk staff record the requests manually in order to answer them. It would be a great idea if

an automatic management system is designed to watch multiple rooms and continuously monitor their requests until answered.[4]

1.3 Phone over Power Line Management System

Phone services in hospitals and hotels are extended to patients and guests at an extra charge. Wiring of phone lines in a hotel can be cumbersome. Monitoring of the phone calls and durations need to be done for each guest (room). It would also be a very good idea if the existing power lines are used to extend the phone service to every room in a hospital or hotel. In addition it would be very helpful if the automatic system continues to watch phone call requests and monitor the length of established calls and calculate the total cost of each call for billing.

II. SECURITY AND PARKING LOT MANAGEMENT SYTEM

2.1 Security

Due to technological advances in manufacturing, cameras are very affordable, abundant, and being used nowadays to monitor and record all activities within certain places. For example banks, airports, government facilities, and even supermarkets are equipped with different cameras that keep recording and tracking activities inside and outside those facilities. Normally, a camera and a video recording system is installed at the gate of the building to take photographs or a slow motion video and record them along with a timing stamp which tells the reviewer of these records the time and date information. Such systems will allow retrieving the photographs taken within a defined period of time. The cost for such systems is divided into two parts: the cost of the camera which is usually not very high and the cost of the recording system which contributes more to the total cost. Also, the recording media might be an analog media such as video tape or a digital media such as a hard disk or a compact disk.

Generally, the cost of digital media continues to decrease with advances in digital technology. So, it might be a very cost effective solution to use a personal computer with all of its capabilities to perform the function of a video or photographs recorder. This is possible because of two specific features in new personal computers which are used nowadays. The first feature is the large hard disk which can run up to several hundreds of Gigabytes. This feature makes the computer capable of holding large amounts of digital information required for the application of digital photographs recording. The second feature is the USB cameras that can be interfaced to the USB port which is now standard port in all personal computers. [2]

2.2 Alternative Solutions

A draw back is that current security systems employ cameras that keep running and recording continuously regardless of activity taking place or not. Such practice produces huge amount of recorded data and requires huge storage capacity especially when high resolution cameras are used. As a result the captured data quickly fills the storage devices being used. In order to provide a solution for this problem, three things can be done.

a) Keep increasing storage capacity to provide enough space for the new captured data.
b) Use lower resolution cameras whose images are smaller, less clear, and thus require less storage capacity.
c) Recycle data by erasing older data and replacing it with newly captured data.

Although such solutions help tremendously in providing storage space for storing new captured data, they possess certain disadvantages. First, continuously increasing storage capacity requires continuous purchasing of new storage media and is cost ineffective. Secondly, using lower resolution cameras require less storage capacity however such cameras capture images that do not provide clear pictures of persons that might need to be identified in case of problems. Thirdly, recycling data removes the need for providing new storage media or the need to use lower resolution cameras but requires erasing older recorded data that might be needed at a much later time.

III. PARKING LOT MANAGEMENT

Any parking lot has limited capacity. When the number of cars in a parking lot exceeds its designated capacity, illegal parking starts becoming an issue that causes many further problems. It is very hard for a parking lot manager to keep track of the number of vehicles that entered the parking lot and the number of cars that left the parking lot especially in parking lots that operate over extended time periods and cover large areas. When parking lot supervisors change shifts, the new supervisor has no information to the number of cars in the parking lot. In addition if the supervisor leaves his desk for prayer for example, he would not be able to know the number of cars that entered and left the parking lot during that time. This would mean that each incident such as the one mentioned will cause a problem in counting. [3]

3.1 Alternative solution

The supervisor can close the parking lot entrance and exist until he is done with prayer. Or the supervisor can recount the cars in the parking lot. Or two supervisors need to be on duty all the time. All of those solutions are not practical.

3.2 Proposed Solution

The problem definition suggests designing an automatic counting system that can help tremendously in managing the parking lot. This allows the supervisor to close the parking lot when the number of cars inside the parking lot reaches the maximum capacity. Also the system needs to employ a security camera that will take pictures of cars entering the parking lot or leaving it. The system should be smart on saving storage space. The Parking Lot Control and Security System is described best by the following list of actions:

[1] The system will be interfaced to the computer.
[2] Will monitor vehicle entrance.
[3] Will monitor vehicle exit.
[4] Keep count of number of empty spaces in the parking lot.
[5] Upon car entry or exit the camera will be turned on to take a picture.
[6] All pictures will be time stamped for easy filing.

Following is a block diagram that best describes the functionality of the two systems integrated together.

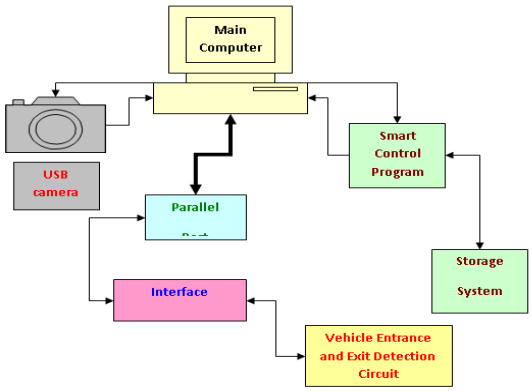

Figure 2 1: Computer-Based parking Lot control and security system

IV. SERVICE REQUEST MANAGEMENT AND TRACKING SYSTEM

Service request management systems generally employ manual recording of requests from different rooms. When handling many rooms and under work stress, service personnel tend to miss some requests unanswered. An alternative solution to this problem is to employ dedicated supervisors that can be costly.

4.1 Proposed Solution

The proposed solution is to design and build a control and monitoring system that can be used for hospitals and hotels. The system will be designed to perform the following functions.

[1] This system will be designed to serve a total of 5 rooms simultaneously.
[2] Each room is to be equipped with a service request button.
[3] Calls or requests from all rooms are to be monitored simultaneously via a main computer that is located at the nurse monitoring room or service desk.
[4] Upon receiving a request a visual notification and audio alarm is to be turned on to attract the attention of the service desk personnel or the nurses.
[5] The monitoring computer will display a message showing the room number that requested the service.
[6] The message window is to provide a button that can be clicked to acknowledge that a nurse or service team member is going to attend the call.
[7] The system will track all events by recording all calls and requests initiation times, the acknowledgment times, and answer times.
[8] A status report is to be available via network at the supervisor computer.
[9] The system will allow the supervisor to monitor the service desk computer via the network.

Following is a block diagram that best describes the functionality of the service request management system.

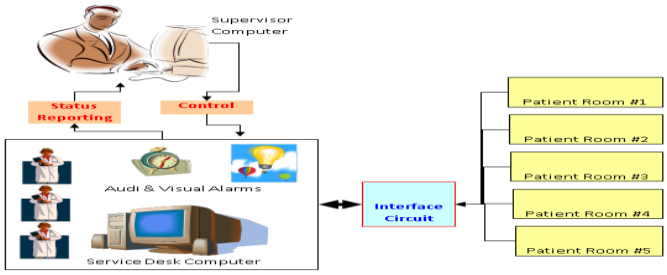

Figure 2 2: Block Diagram of service request management and tracking System

V. TELEPHONE OVER POWER LINE MANAGEMENT SYSTEM

Telephone service need to be extended to guests in hotels and hospitals. Designated (numbers) phone lines can be extended to every room. However the incurred subscription cost can get outrageously high. In addition sophisticated monitoring system needs to be employed to keep track of carried out calls for billing purposes. Cost of such systems is in general very high. Since phone lines in hotel and hospital rooms are not used a lot, there is no need to subscribe to many services from the phone company. Rather a small number of lines can be shared and extended for all rooms. The service can be extended to a room only upon request. When the phone call is done the phone service is free to be extended to other rooms. Selectively extending the phone service to many rooms in the building can be done in different ways.[5]

5.1 Alternative Solutions

Dedicated lines can be laid from the service desk to every room in the building. This requires extensive labor and construction work. Wireless connections can also be employed to every room. However the cost can be very high.

5.2 Proposed Solution

The proposed solution is to utilize the existing power lines that extend to multiple points in every room to carry the phone service. The control system will connect the phone line signal to the room that requests external calling via power lines. When the guest at the requesting room starts the phone call the system will keep track of the time. When the guest hangs up the phone the system will stop the timer and calculate the appropriate charge.

[1] The system will monitor a request signal from the guest room.
[2] The system will use a transmitter and receiver to carry phone conversation over power lines.
[3] A control circuit will be designed to connect the phone line to the intercom module.
[4] Upon connection of call a timer will be started.
[5] The timer will be stopped automatically when the guest hangs up.
[6] The system will display the total charge and records it in a log file.
[7] The system will be built and tested.

Following is a block diagram that best describes the functionality of the telephone over power line management system.

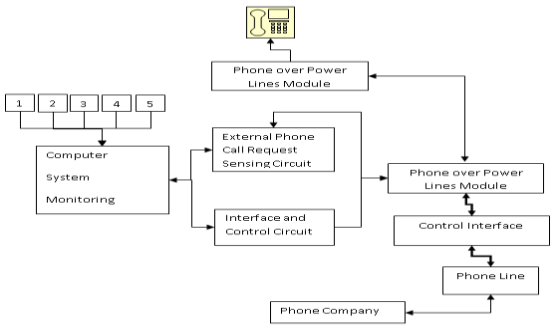

Figure 2 3: Block Diagram of the calling system control and charging

VI. SECURITY AND PARKING LOT MANAGEMENT

The hardware requirement for this paper consists of the following elements:

[1] A parallel port connection that gives access to the different lines of the parallel port. This will allow the outside circuits to be interfaced to the parallel port.
[2] A USB camera along with its software. The camera will be used to capture the images.
[3] Dual infrared detection circuits that will be used to detect the presence of a car entering the parking lot or leaving it.

The infrared detection circuit will be discussed in the following section.

6.1 Car Detection Circuit

Each car detection circuit is used in our paper in to detect the event when an object crosses a certain line. The detection circuit consists of two parts. The first part is an infra red transmitter that continuously transmits infra red light in the direction of an infra red receiver. The second part is an infra red receiver that is aligned with the transmitter for best performance. A block diagram of the transmitter and receiver with no obstruction is shown below in the following figure.

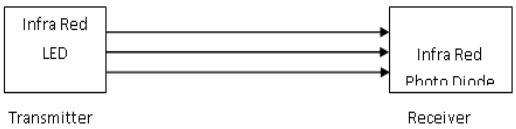

Figure 4 2: Block Diagram of the intrusion detection circuit with no obstruction.

When an object crosses the door or line, the infra red light is obstructed from reaching the receiver. A block diagram of the transmitter and receiver in the presence of an object is shown in the following figure.

Figure 4 3: Block Diagram of the Vehicle detection Circuit with obstruction

6.2 Transmitter

To implement the transmitter we require a light source. The most economical choice of light sources is a light emitting diode. There are two types of light emitting diodes. They are Infra Red Light Emitting Diodes IRLED and Visible Light Emitting Diodes VLED. For most through applications the infrared light emitting diode (IRLED) is the most common choice. Although visible light emitting devices do exist, the infrared parts are generally chosen for their higher efficiency and more favorable wavelength, especially when used with silicon photo diode light detectors. Samples of Light emitters are shown in the following figure.
The transmitter in our paper uses an Infra Red LED that is connected through a 100 ohm resistor to VCC (7V). The circuit diagram is shown in Figure 12. The transmitter is continuously transmitting and is supplied with 7V through an external power supply. The IR transmitter used in this paper is the LD271.

6.3 Receiver

The receiver that will receive the infra red light is designed using a photo diode that connects when infra red light falls on it. The IR receiver used is the BPW42 and its wavelength matches the wavelength of the LD271 transmitter. When no light falls on the photo diode it doesn't conduct. The red LED is used to indicate the presence of an object. When no object is present, the IR receiver conducts current and the Red LED turns on. When an object obstructs the IR source from reaching the IR receiver, the IR diode stops conducting and the current becomes zero. When the current is zero, the Red LED turns off. The voltage between the resistor and the IR receiver diode is zero when there is an object obstructing the IR rays and around one volt when there are no obstacles. The one volt value changes according to the distance between the transmitter and receiver, strength of the transmitter, and other elements in the circuit. In our case the high voltage at the point is one volt. This voltage is too low and would be considered zero by the computer port since it is way lower than 5 volts that defines logic one. Thus an interface circuit is to be designed to perform level shifting from 1 volt to 5 volt.

6.4 Car entering or Exiting

We need to differentiate between cars entering the parking lot and exiting it. This section demonstrates the scenarios of each case.

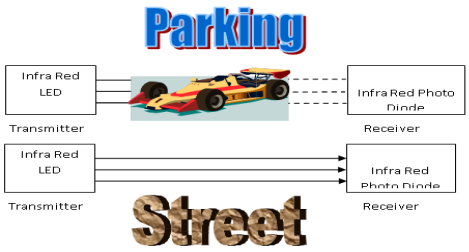

Figure 4 6: Sequence of car entering the parking lot

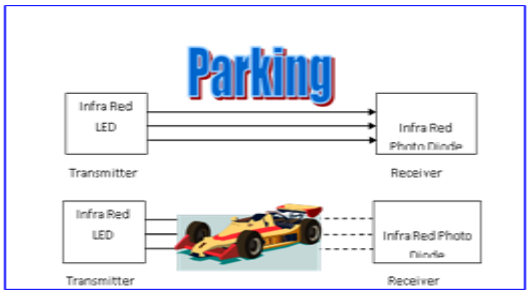

Figure 4 6: Sequence of car exiting the parking lot

6.5 Car detection Circuit

The system requires two car detection circuits placed sequential at the parking lot entrance. The following circuit diagram shows the design we implemented twice to perform the required fuction.

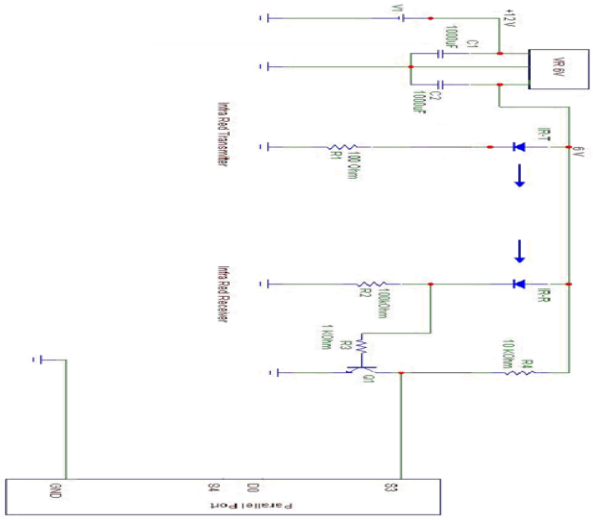

Figure 4 7: Car detection circuit with connection to parallel port

The circuit that is shown above performs a level shifting task by utilizing a transistor to amplify the small signal. The transistor used is an NPN transistor (2N2222). When the voltage at the output of the IR receiver diode is zero (object present), the voltage at the base of the transistor Q1 is zero. This causes the transistor to turn off and the voltage at its collector is equal to VCC. Thus the presence of an object is indicated by a logic one at the input pins of the parallel port of the computer. When no object is present, the voltage at the output of the IR receiver diode is around 1 volt. This voltage will be present at the base of the transistor causing it to turn on. When the transistor turns on, the voltage at its collector drops down close to zero. Thus the absence of an object is indicated by logic zero at the input of the parallel port.

	IR Detector Output
Car Present	High
Car not present	Low

VII. SERVICE REQUEST MANAGEMENT

The hardware requirement for this system consists of the following elements:

[1] A parallel port connection that gives access to the different lines of the parallel port. This will allow the outside circuits to be interfaced to the parallel port.
[2] Sensing circuits that will be placed at different rooms.
[3] Multiplexing circuit.

The total number of input pins available in the parallel port is 5. Since two of those ports need to be used for the car detection circuits and we need 5 more for this system. It is necessary to increase the capacity of the parallel port. This is done by multiplexing the signals. This is done using a multiplexer with select line. The multiplexer to be used is the 74ls157. The 74LS157 is shown in the next figure.

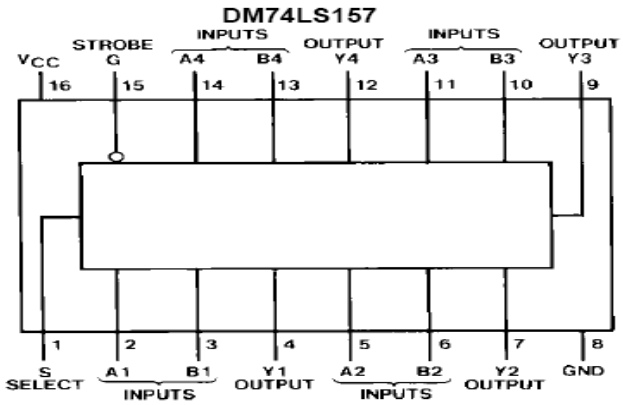

Figure 4 8: Block diagram of 74LS157

The next figure shows the logic diagram of the used multiplexer with select line (74LS157)

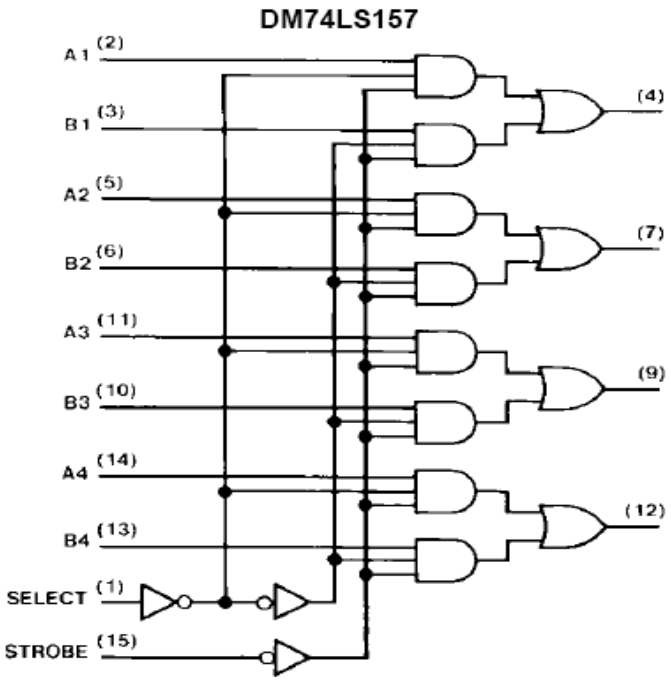

Figure 4 9: Block diagram of 74LS157

The operation of the 74LS157, Quad 2 line to 1 line multiplexer is quite simple. It simply acts as four switches. When the A/B input is low, the A inputs are selected. E.g. 1A passes through to 1Y, 2A passes through to 2Y etc. When the A/B is high, the B inputs are selected. The Y outputs are connected up to the Parallel Port's status port, in such a manner that it represents the MSnibble of the status register. While this is not necessary, it makes the software easier.

To use this circuit, first we must initialize the multiplexer to switch either inputs A or B. We will read the LSnibble first, thus we must place A/B low. The strobe is hardware inverted, thus we must set Bit 0 of the control port to get a low on Pin 1.

7.1 Service Request Detection Circuit

The system requires five service request detection circuits placed at each room. The system needs to check all rooms continuously and simultaneously. The following circuit diagram shows the design we implemented to perform the required function.

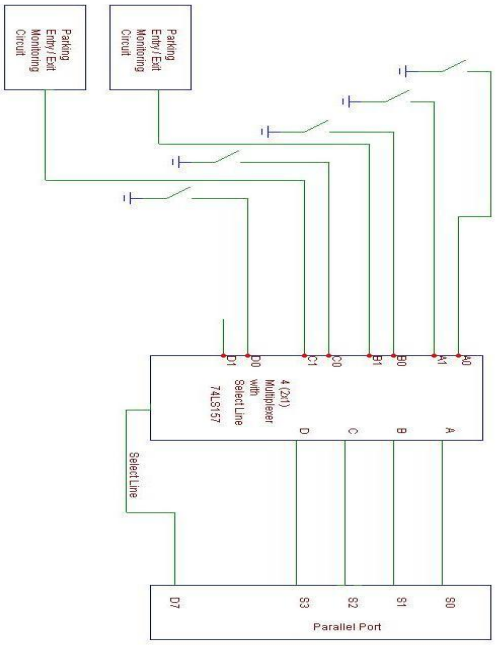

Figure 4 10: Service request monitoring circuit diagram

7.2 Phone over power Line System

It is possible to communicate audio signals from telephone to another using the power lines as the communication medium or channel. However, since AC voltage is also present on the power lines, some sort of isolation will be required between the AC voltage and the audio signal. This can be achieved using modulation and coupling. Since power lines are running everywhere in houses and buildings, it is very convenient to use the power lines as communication medium. Audio over power lines is used in wireless intercom systems. They are called wireless because the audio signal does not need special wires to be transmitted on. These intercoms are not only popular in households, but are also becoming common in the workplace. A wireless intercom allows people to communicate instantly with each other through the push of a button. Business owners and homeowners alike are realizing many uses for these intercom systems. Some wireless intercom can be used as two-way communication.

A wireless intercom system has the advantage of simple installation, while traditional intercom systems require wires to connect each intercom placed throughout the building or home. The cost of installing wires to run throughout the walls and ceilings of a building far surpasses the cost of purchasing the intercom system itself, and a wireless intercom requires no installation. Wireless intercoms need only be plugged into AC power outlets throughout the home or office. Battery operated wireless intercom systems don't even require this step, have had much success, and perform just as well as their AC counterparts. The only downside of battery operated systems is that the batteries must be replaced regularly.

Once your wireless intercoms are in place, a person in the basement of a house, for example, can speak to someone on the second floor with just the push of a button. Utilizing an intercom system prevents the need to shout or run up and down stairs to communicate. Many wireless intercom systems have a range of nearly 1,000 feet (304.8 meters), making them ideal for the home or workplace. But some systems can communicate up to 6,500 feet (2KM) [6]

VIII. DEVELOPMENT OF SOFTWARE IN MATLAB

8.1 Main Interface Program Logic

The software functionality is outlined in the following list.

[1] Start Main Interface window
[2] Monitor User Selection
[3] If selection is for Parking system, Start Parking program
[4] If selection is for Room service monitoring, start room service program
[5] If selection is for phone over power line, start phone program
[6]

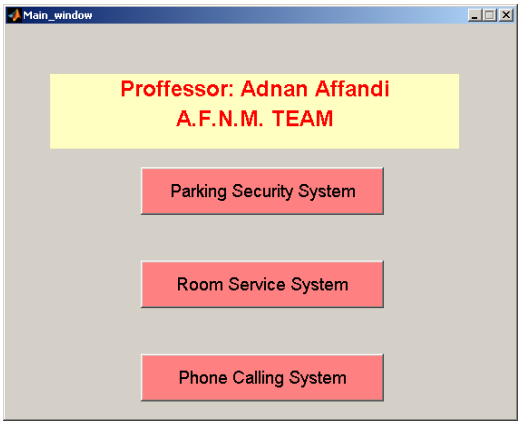

Figure 5 1: Main Program Interface

8.2 Security and Parking System

The software functionality is outlined in the following list.

[1] Read start time and stop time
[2] Create Parallel Port object
[3] Add hardware lines
[4] Create Video Object
[5] Create Sound Alarm tone
[6] Check Sound System and waves
[7] Initialize all data fields
[8] Read Parallel port values
[9] Determine if car is entering
[10] Increase car count display field
[11] Take picture
[12] Determine time
[13] Generate image name
[14] Save image
[15] Determine if car is exiting
[16] Decrease car count display field
[17] Take picture
[18] Determine time
[19] Generate image name
[20] Save image
[21] Open log file
[22] Update Information and record activity
[23] Close file
[24] Go back to step 8

Figure 5 2: Security and Parking Interface

8.3 Room Service Request System for Hospitals and Hotels

The software functionality is outlined in the following list.

[1] Read start time and stop time
[2] Create Parallel Port object
[3] Add hardware lines
[4] Create Sound Alarm tone
[5] Check Sound System and waves
[6] Initialize all data fields
[7] Read Parallel port values
[8] Determine if service is being requested
[9] Find the room number requesting service
[10] Display control to answer service and room number requesting service
[11] If service request is answered close the previous control
[12] Open log file
[13] Update Information and record activity
[14] Close file
[15] Go back to step 7

Figure 5 3(a): Room service Interface

Figure 5-3(b): Informations about Room No.1

8.4 Phone Service System For Hospitals & Hotels

The software functionality is outlined in the following list.

[1] Read start time and stop time
[2] Create Parallel Port object
[3] Add hardware lines
[4] Create Sound Alarm tone
[5] Check Sound System and waves
[6] Initialize all data fields
[7] Read Parallel port values
[8] Determine if service is being requested
[9] Find the room number requesting service
[10] Display control to answer service and room number requesting service
[11] Start timer when call starts
[12] determine if phone call ended
[13] stop timer
[14] calculate total fee
[15] Open log file
[16] Update Information and record activity
[17] Close file
[18] Go back to step 7

By using software, we can get information about rooms in Hospitals and Hotels . In Fig.5-3(a) we can see Room No.1 has a patient named Abdullah and he is suffering from eye problem. We have all his details about his problems. Both Patient and Nurse can communicate easily any time.

Figure 5-3(a): Phone Service System for Hospitals

IX . IMPLEMENTATION OF PAPER

9.1 Built Model

The system was built and tested numerous times. The following figures show the different circuits and model that was built.

Figure 6 1(b): Model Picture

X. CONCLUSION

With all events taking place around the world, security concerns are continuously on the rise. As a consequence of wars, conflicts, or social problems, security concerns must be thoroughly evaluated and necessary measures must be taken in order to reduce risks and improve the safety of people, assets, and facilities. Many places need to be kept secure from intruders or suspects. Parking Lots are provided for visitors of all government buildings, hotels, hospitals, and large buildings. They have been a prime security concern, as many incidents of terrorism were carried out by implanting cars with bombs in parking lots of important buildings. Management and security of parking lots is a continuous challenge. It would be a great idea if an automatic management and security system is designed to continuously manage and watch a parking lot.

Modern hospitals and hotels are of great importance for nowadays civilized communities. Hospitals extend their medical services to all people, adults and children. Hotels extend their services to most travelers from within the country or from outside the country. Millions of people use the services of hotels and hospitals throughout the world daily. Modern hospitals and hotels of nowadays have high tech equipments that are used for many different purposes. These equipments integrate advanced electronics and computer systems to provide extremely useful tools. Nurses in hospitals continuously watch patients that stay at different rooms. These patients require some assistance at certain times. The on duty nurse is supposed to answer the requests from different patients and address their demands or concerns.Similarly in hotels many rooms are occupied by hundreds of guests daily. These guests have different demands that need to be answered in order to keep the service quality of the hotel at a higher class. Current service request management systems located at hospitals produce an audio and a visual alarm at the nurse desk indicating that requests have been issued. The nurse should keep track manually of the requests. Work stress can cause the nurse to miss some of the requests or answer some requests before others. Similarly in hotels requests are in general placed by the guests via telephone. The help desk staff record the requests manually in order to answer them. It would be a great idea if an automatic management system is designed to watch multiple rooms and continuously monitor their requests until answered.

Phone services in hospitals and hotels are extended to patients and guests at an extra charge. Wiring of phone lines in a hotel can be cumbersome. Monitoring of the phone calls and durations need to be done for each guest (room). It would also be a very good idea if the existing power lines are used to extend the phone service to every room in a hospital or hotel. In addition it would be very helpful if the automatic system continues to watch phone call requests and monitor the length of established calls and calculate the total cost of each call for billing. In this paper we designed and built an automatic parking lot management system that keeps track of vehicles entering and leaving a parking lot. Another system was designed and built to record (using a camera) activities of cars entering and leaving the parking lot. Developed programs are simple to use and employ a visual interface design. Secondly we designed and built an automatic service request management system. This system keeps track of all requests from different rooms and keeps a record of them. The system was developed to run using a personal computer. Developed programs are simple to use and employ a visual interface design. Thirdly we designed and built an automatic phone call management system that utilizes the existing power lines as the phone call carrier medium. The system is able to detect automatically the phone call request from the room and indicate this on the computer interface. Upon establishing the phone call, the system keeps track of the time period of the call and generates and save the total cost of the call. The system automatically detects the end of conversation. The system was developed to run using a personal computer. Developed programs are simple to use and employ a visual interface design.

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