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Operation Theatre Automation and Control (OTAC)

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Abstract - Smart bed to non-intrusively monitor patient respiration, heart rate and movement using spatially distributed integrating multimode fiber optic sensors. The research is focused upon allowing more automation of patient care, an especially important matter for the elder population, which is a rapidly growing fraction of much of the world population today. Two spatially integrating fiber optic sensors are investigated, one of which was based on inter-modal interference and the other on mode conversion. The sensing fiber was integrated into a bed and test subjects were monitored in different positions. The sensor outputs were then correlated with subject movement, respiration rate and heart rate. The results indicated that the inter-modal sensor could detect patient movement and respiration rate while the mode conversion sensor could detect patient movement, respiration rate and heart rate. Results and analysis of the research are presented and future research activities discussed in this project we present the results of research aimed at the development of a 'smart' bed to non-intrusively monitor patient respiration, heart rate and movement using spatially distributed integrating multimode fiber optic sensors. The research is focused upon allowing more automation of patient care, an especially important matter for the elder population, which is a rapidly growing fraction of much of the world population today.

***Key Words*: anaesthesia control level bed monitor temperature monitor rectangular slab**

1. INTRODUCTION

The continuing shortage of medical staff and the increase in the elder population due to the baby boom after World War II make the automation of health care an ever-increasing priority. In particular, patient monitoring is very intrusive and labor intensive. In this project we have aimed at the development of a 'smart' bed to non-intrusively monitor patient respiration, heart rate and movement using spatially distributed integrating fiber optic sensors. In nursing homes and extended care facilities. The measurement of the respiration rate and heart rate provides an immediate indication of whether a patient is in any distress, while the measurement of patient movement can be used to determine Monitoring of essential vital signs is an integral part of medical care. The pulse rate can be determined by placing of electrodes on the skin and monitoring of the electrocardiogram. Any of these sensors can cause skin irritation or breakdown and may contribute to patient discomfort. Pressure sores are a major cause of morbidity and mortality in the healthcare setting. Finally, future planned research activity is described.

The main aim of this project conceals itself to the automation of the medical treatment to arise to a smart bed system providing comfortable care to the patients & meet the needs of the trending technology by monitoring patient respiration, heart rate and movement using spatially distributed integrating multimode fiber optic sensors.

2. LITERATURE SURVEY

In this paper we also illustrate the application of the model to the weekly planning of the OT in a medium-sized hospital in Tuscany. In particular, we explicitly take into account various tactical strategic issues raised by the hospital management.

In this paper, we investigate surgical planning problems at the operational level from a broader perspective which considers surgical and post-surgical processes in an integrated way. We propose a new mathematical formulation for SCALP, and we show how it can be exploited as a management decision tool both in operational as well as strategic decision making. The typical pathway for the post-surgical patient is to either mettle patient to an intensive care unit (ICU) if his/her health conditions are critical, or move him/her directly to a vary delivering the needed level of care. Specifically, we define three types of wards with different card levels: Day Surgery (or Low-Intensity, where the patient typically stays before being discharged home on the same day of the surgery), Medium-Intensity and High-Intensity. Our model explicitly takes into account a number of issues which are encountered in clinical practice, but are often neglected, including:• There are the different levels of intensity of cam. These levels correspond to having different bedroom types, surgical and OR ses-sons. Bods are located into rooms, cach room must contain patients of the same sex and having compatible levels of intensity of care. Surgical assignment takes into account the skill of the surgeon's available on each day of the planning horizon.

Key: **elective surgeries with detailed bed levelling**

In the first paper in order to develop a non-intrusive method of detecting respiration, the use of point sensors was ruled out due to the possibility of continual shifting of the patient position. Instead, a spatially distributed integrating approach was chosen so that if a patient were present anywhere within a specific localized area, sensing could be carried out. The basic concept is that any patient movement that also moved an optical fiber within the specified area would produce a change in optical signal that would indicate patient movement. The physical repetitive movement caused by respiration or heart pumping would be contained within the signal as well and could be extracted via appropriate signal processing. To test this concept, two different modal modulation approaches were used with multimode optical fiber excited by a coherent laser source. In the first technique (statistical mode sensing (STM)), all the guided modes of the fiber are excited and then detected by a low cost digital camera. This is shown schematically in figure 1. The sum of the absolute values of the change in light intensity on each of the pixels between each timeframe is then calculated. This technique then provides a measure of the absolute value of the first time derivative of a perturbation integral along the fiber length. In the second approach (high order mode excitation (HOME), only the higher order modes of the fiber are excited so that the output from the unperturbed fiber results in a bright annulus when projected on a screen. A large area circular photodetectors positioned so that its diameter fits within the annulus but does not intercept it. This technique provides a signal that is directly proportional to the perturbation integral along the fiber length.

Key: patient movement within a specific area using optical Fiber

In paper two it was discussed overall average bed occupancy in the hospital was 86%. It can be seen that the bed occupancy for hospital is over capacity. This is due to the high demand for bed ward because of its heavy subsidy. As a result, patients are up-lodged to metal bed while paying controlled bed rates. The lowest occupancy rate for General Medicine and other unclassified discipline occurs on Friday and Sunday respectively, whereas the minimum occupancy for rest of the disciplines lies on Saturday. There was a seasonal pattern in respiratory Medicine with peak points observed during January and May-June period. This is mainly due to the onset of the flu season during both periods resulting in higher number of respiratory related diseases. A sharp peak point was also observed in Infectious Disease during October period due to the outbreak of dengue fever. Cardiology and Geriatric Medicine displayed wide fluctuations in occupancy level. In general, it can be observed that the greatest fall in occupancy levels occurred during Chinese New Year for most disciplines. From Fig. 1, it can be seen that there is a very strong Lunar New Year effect stretching from two days prior to New Year to 7h day of new year with a drop of 14%in occupancy from the mean during this period. The Christmas effect is also significant during the last week of the calendar year with a drop in occupancy of 5%.

In the local context, there is nil existence of four seasons, however, for a multi-racial nation considerations would have to be catered for special events/ festivals.

Key: Predicting bed Using Regression Models

In paper three the evoked muscle response after supra maximal stimulation of its motoric nerve (e.g. ulnaris nerve - adductor pollicis muscle) can be registered by electromyography (EMG), mechanomyography (MMG) or acceleromyography(AMG). For example the research group in Sheffield used the "Relaxograph NMT 100" (Fa.Datex) . This device was also used by Mendonca et al . Other groups use the AMG .Based "NMT-module" .The usual method to record the degree of muscle relaxation is based on a stimulation of a peripheral nerve and the respective measurement of the muscle response. The period of stimulation is limited to 10– 12s because of the necessary physiological regeneration of the muscles. Since in a lot of applications the set point of 90% neuromuscular blockade is prescribed, other stimulation patterns like train-of-four (TOF,a series of four stimulations in an interval of 500ms)

are with regard to the twitch suppression not more effective than the T1-stimulation. By using the single-twitch stimulation mode (one twitch every 12 sec.) a control value (T1/TO) is needed prior to the application of the muscle relaxant. The T1 value decreases after an initial bolus injection and the neuromuscular block increases.

Key: **Rostocker Assistant System of anesthesia control**

In this paper, we have studies to monitor hospital rooms using depth images used manually placed "markers" at specific locations such as the head of the patient, the ventilator, the staff computer. These selected points were then used to trigger specific activities related to the interaction of the hospital staff and the patient such as documentation observing, checking diagnostics, urinary catheter removal, and ventilator use. Along with this, the researchers also

computed the orientation of the 3D data of the foreground at each image frame. These features were then input to classifiers to identify the activities. The classifiers implemented were the Support Vector Machine as well as the Decision Forest classifiers. The latter achieved a better performance with an average overall classification rate of 75%. Here, data were collected in an ICU Unit for a period of approximately 5hours. In another approach used combination of Histogram of Oriented Gradients(HOG), Histogram of Optical Flow (HOF) and Motion History Images (MHI) to get a 48 dimensional feature vector for the manually selected bed region. This was then input to a Multiple Kernel Learning classifier to detect the event "patient gets up from the bed". The results were tested on .5 hours data from a hospital room to achieve and overall accuracy rate of 98%. In bed detection algorithms, used Hough Transform to detect all lines in the color image from regular camera data after extracting the edges using the canny edge detected and then classified the lines into four categories (four sides of the bed) based on the angle and mid-point location constraints. We detect the largest non-ground horizontal surface present in the scene and estimate thegradients of the surface.

The results were tested on around 1000images randomly sampled from ten different data sets. The algorithm failed to detect some of the edges when there were nursing staff too close to the bed or when there were visitors which seemed to be the major drawback of this technique

Key: Monitoring Patients in Hospital Beds Using Unobtrusive

In this paper, an on-off closed loop control system has been implemented on PIC16F876A microcontroller which takes its input from LM35 temperature sensor in control theory, a controller is a device which monitors and affects the operational conditions of a given dynamical system. The operational conditions are typically referred to as output variables of the system which can be affected by adjusting certain input variables. The controller is used to modify the characteristics of the system so it behaves in a specific desirable way over time. All these are being accomplished today by control engineering principle. The closed-loop nature of the system is clearly indicated by which consists of an automatic controller, an actuator, a plant (Room temperature) and a sensor (measuring element, temperature transducer). The controller compares the actual value of the plant output (Room temperature) with the reference input (desired value), determines the deviation, and produces a control signal that will reduce the deviation to zero or to a small value. The manner in which the automatic controller produces the control signal is called the control action. The output of an automatic controller is fed to actuators(which are devices such as relays and switches). The sensor converts the measured input into electrical signal so that it can be used to compare the output to the reference input signal. This element is in the feedback path of the closed-loop system.

Key: Monitoring Patients in Hospital Beds Using Unobtrusive Depth Sensors

In this paper, system is called Remote Temperature Monitoring Using LM35 sensor and Intimate Android user viaC2DM Service monitoring rooms temperature using LM35sensor designed by Poonam. This system is used to anticipate the fire. Arduino will process the temperature information sent by the LM35 sensor if the temperature exceeds normal one. After that, the system will send the notification to an Android Smartphone through GPRS. we investigate we made comparisons with some of the previous works related to this topic, such as: Real Time Temperature Monitoring Using LABVIEW and Arduino designed by Vaibhav M. Davande, Pradeep C. Dhana wade, Vinayak, and Remote Temperature Monitoring Using LM35 sensors and Intimate Android users via C2DM Service compiled by Poonam and Real Time Remote Temperature& Humidity Monitoring Using Arduino and Xbee S2 by RohitD. Kulkarni and Vijay S. Kale [5]. A web-based temperature monitoring system for the college of arts and letters by R.Solorio

Vaibhav's system is monitors the temperature and humidity use LABVIEW and Arduino, in order to check the

temperature change using the sensor Thermistors with NTC types with temperature senses from -50 to 200 Celsius degrees. The Arduino will runs a program which connect Arduino with NTC sensor. That sensor will read room's temperature. After that Arduino will send the data to Lab view. If the temperature exceeds the normal temperature, the "ON" LED light will be activated and the DC motor will get activated as well. Otherwise, both "ON" LED light and DC motor will not be activated. This air conditioning control and monitoring were Proven that they are cost efficient.

The second Thanks to this system, the possibility of danger can be minimized

Key: Monitoring Temperature and Humidity Web Based Monitoring Using Microcontroller

In this paper we investigate To satisfy the needs of the target users identified by the method described above, we executed an idea-generation process. The Smart Bed System was developed on the basis of the concept of using technologies such as vital-sign sensing and network communications while envisioning its use at both medical care sites such as hospitals and care giving sites such as care homes and patients' own homes. With these preconditions established, we encouraged free and open thinking to illustrate a future method of using a bed in a way that would provide value to users. In particular, we used techniques like brainstorming to generate a wide range of ideas. In this way, we were able to distinguish different viewpoints by sharing each other's ideas in addition to generating ideas individually. We were also able to generate new ideas by combining the obtained ideas. The generated idea was then presented through illustrations that could be posted on a wall using the "gallery walk" method so that all workshop participants could look them over. By voting on the ideas that best expressed the sentiments targeted by this project and that viewers could strongly empathize with, we narrowed down what should be focused on and compiled the points that should be conveyed in the video.

Key: Vision Design for Smart Bed System of Paramount Bed

First, we describe the preconditions of the equipment. The camera installation range is represented by the hatched area in Fi In addition the camera height is fixed at 1700 [mm], and is equipped with a wide-angle lens. By using a wide-angle lens, the bed is completely contained within the image regardless of where the camera is placed in the specified installation range. The camera angles of view are 170° and 100° in the horizontal and vertical fields, respectively. When the optical axis of the camera is set to a tilt angle of 45° and the horizontal direction of the wall surface is set to 0°, the pan angle is fixed at 90°. At night, the auxiliary light of the LED, which emit sin frared wavelength of approximately 900 [nm], is on. The light emission source of this auxiliary light has a longer wavelength than that visible to the human eye. In the proposed method, a small rectangular region of an input image is selected as a bed candidate region. Moreover, based on the luminance information of the candidate region, the likelihood of the candidate region is calculated. The bed candidate area is scanned over the entire image, and the place with the highest likelihood is determined as a bed. In the likelihood calculation process of the candidate region, the HOG feature is extracted using the luminance information in the candidate region, and the likelihood for the HOG feature is calculated using the support machine classifier (SVM) classifier. However, as described in the explanation of the precondition, our system allows the position of the camera to be variable within a certain area. Therefore, the appearance of the bed shape is different for each position of the camera.

As a result, it is impossible to calculate the likelihood correctly. To solve this problem, we apply a plan a perspective transformation to the input image as preprocessing. By transforming the viewpoint to the vertically upward direction in the room using viewpoint conversion for the input image, it is possible to obtain a rectangular bed shape, regardless of the camera position in the installation area. Details of the viewpoint conversion processing are described in the following section.

Key: Vision-based Bed Detection for Hospital Patient Monitoring System

In this paper, we investigated that this work presents the results of a survey on electric medical beds from the year 2000, and up to 2016. Three different topics were assessed:

a) Trends and changes found in medical beds over this period (section "Twenty-first century medical beds: Trends and changes 20002016 ").

b) Current market-reach and features of smart beds(section "Twenty-first century medical beds:

Current market-reach and features").

c) Research efforts with an impact on the experience or capabilities of the medical bed, as part of more

comprehensive healthcare environments (section "Research shaping the future of smart health care environments").

As a characterization of the current state of a specific medical device, sources for this article have been the result of a thorough literature survey on its core subject(medical, long-term care beds, patients and operators).In order to form a comprehensive view on the matter and its perspectives, however, other relevant sources representing economic, social/political and cultural implications to such a relevant medical device were also.

key: **smart medical beds in patient-care environments of the twenty-first century**

3. PROPOSED WORK

The idea for this proposed to design an automated operating theatre (OTAC) where all the things can be automated and can be monitored at regular basis. All these things will be controlled automatically or at the wishes of the operator (doctor in our case). Explaining the features one a time,

The Operation theatre lamps needs to be adjusted for the right intensity--, For this we connect a stepper motor based intensity controller (Variable Resistor) which will be able to control the intensity and the input for this comes from the User selectable menu on the GUI made in VB.

Level controlled bed— whose height can be altered to suit the height requirement of our surgeon who might feel it uncomfortable in bending or over erecting for a long periods of time To do this we will be employing a string pulled bed controlled by a stepper motor.

Monitoring Anesthesia doses:-- Usually the anesthetist is required to administer the right dose of anesthesia to make the patient sleep for right amount of time, neither too long nor too less. For doing this he calculates the exact dosage of the medicine to be administered but due to human errors sometimes the medicine is slightly over or under administered. To overcome this problem we propose a rack and pinion motion controlled syringe holding mechanism which will control the flow of the liquid being injected in to the body of the patient.

The blood agitator is a mechanism— which prevents the blood from getting coagulated in the packet that it is being administered to the patient while being operated upon. This mechanism also has a timer which can stop the agitator and also inform about the time that agitator was moving.

Retractable tray mechanism -- This timer can be preset or can be controlled on the fly from the GUI being made on the Visual basic Front end. To save the storage place we propose a retractable tray loaded with the instruments which can be selected from the GUI on the PC and these trays can open and close (containing the required tools). These trays can be selected by selecting an address for which tray to be operated on. In our prototype we are using two retractable trays mechanism.

Monitoring temperature- The environmental conditions in the room and the body temperature of the patient are also a major factor to be monitored in the Operation Theatre, to achieve this; we shall be connecting two temperature sensors from National Semiconductor (LM35). These sensors are interfaced to the Micro-controller via a Signal Conditioning circuit and an ADC0809 (also from National Semiconductor).

4. CONCLUSION

Human life is very precious and our proposed system **Otac** is a significant attempt to save the life of the patient of in hospital. Besides this, the unique ability of voice automation so that during the time of surgery doctors can ask of required material may be present outside the theatre. In the current design of OTAC will be helpful for doctors to save the life of patient . The structure is made strong enough to sustain all possible loads though it is made flexible at the same time to adjust wider range. In the rescuing operation time is a vital factor which alone can determine the success or failure of the whole operation. Thus, it has been designed keeping the entire consequences in mind that may arise during the operation. We like to conclude with the help of our research project that we will be able to surgery the patient safely.

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