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Predictive Monitoring of Mobile Patients by Combining Clinical Observations with Data From Wearable Sensors

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ABSTRACT

The majority of patients in the hospital are ambulatory and would benefit significantly from predictive and personalized monitoring systems. Such patients are well suited to having their physiological condition monitored using low-power, minimally intrusive wearable sensors. Despite data-collection systems now being manufactured commercially, allowing physiological data to be acquired from mobile patients, little work has been undertaken on the use of the resultant data in a principled manner for robust patient care, including predictive monitoring. Most current devices generate so many false-positive alerts that devices cannot be used for routine clinical practice. This paper explores principled machine learning approaches to interpreting large quantities of continuously acquired, multivariate physiological data, using wearable patient monitors, where the goal is to provide early warning of serious physiological determination, such that a degree of predictive care may be provided. We adopt a oneclass support vector machine formulation, proposing a formulation for determining the free parameters of themodel using partial area under the ROC curve, a method arising from the unique requirements of performing online analysis with data from patient-worn sensors. There are few clinical evaluations of machine learning techniques in the literature, so we present results from a study at the Oxford University Hospitals NHS Trust devised to investigate the large-scale clinical use of patient-worn sensors for predictive monitoring in a ward with a high incidence of patient mortality. We show that our system can combine routine manual observations made by clinical staff with the continuous data acquired from wearable sensors. Practical considerations and recommendations based on our experiences of this clinical study are discussed, in the context of a framework for personalized monitoring.

Keywords: Naive-Bayes, Sensors, Predictive Monitoring.

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I. INTRODUCTION

The majority of patients in the hospital are ambulatory, and thus, they are well suited to be monitored using wearable sensors for the purposes of predictive care. The goal of such systems is to provide early warning of physiological deterioration such that preventative clinical action may be taken to improve patient outcomes. However, the current state of the art is not at a level suitable for wide-scale adoption, and there is a perceived “plague of pilots” in invalidated data collection systems [1]–[3], whereby the majority of published studies are concerned with the demonstration of algorithms using small numbers of subjects, who are often not representative of actual patient groups.

Despite wearable patient monitors now being manufactured commercially, allowing the collection of continuous physiological data from ambulatory patients, the resulting quantity of data acquired each day is large, and a “data deluge” effect occurs. The workload of clinicians and healthcare workers prevents them inspecting long time-series of multivariate patient physiological data to a high degree of accuracy, and the predictive aspect to patient monitoring is lost. “Intelligent,” online processing of these large datasets is, therefore, required for predictive monitoring, the results of which should then focus the limited resources of human experts to those subsets of patients who are deemed to be most at risk of being physiologically unstable, and who are in need of expert review. However, existing clinically validated devices often simply compare physiological data to heuristically determined, univariate thresholds and generate an alert if those thresholds are exceeded (e.g., "alert if heart rate (HR) exceeds 130 beats/min"). Such simplistic schemes result in large numbers of false alerts, which make these devices largely unusable in clinical practice [4]–[6]. Due to the difficulty of acquiring large datasets of patient physiology in clinical trials, there have been few attempts to investigate the large-scale clinical use of wearable patient sensors for predictive monitoring, and this area of e-health remains largely unexplored.

PROJECT IDEA:-

The idea of our project is to build a wireless system for patients such that their health can be monitored 24*7 even when the patient is not in Bed. This will facilitate doctors with checking the patients' health without physically moving from one patient to another and spontaneously take measures when patient is in critical conditions.

II. LITERATURE SURVEY

1. Wireless Health Care Monitoring _K.C.Kavitha, A.Bazil Banu, Volume3, Special Issue3, March2014[IJIRSET] _This paper deals with design and developed for remote patient monitoring in health care field and constantly monitor patients physiological parameters.

2. Data Mining for Wearable Sensors in Health Monitoring Systems: A Review of Recent Trends and Challenges _Hadi Banaee, Mobyen Uddin Ahmedand AmyLoutfi, 17December 2013[Sensors] _Increase of health care services in non-clinical environments using vital signs provided by wearable sensors, this review paper we provided a collection of relevant works.

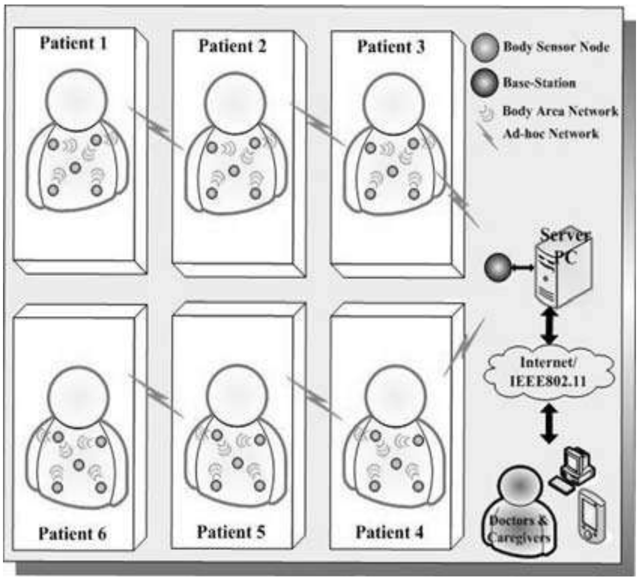
3. Patient Health Man-agement Systemusinge- Health Monitoring Architecture _SrijaniMukherjee, KoustabhDolui, SoumyaKantiDatta, 2014IEEE _This paper illustrates the design and im-plementation of ane-health monitoring networked system.

III. MOTIVATION OF THE PROJECT

In past years, at remote rural areas the peoples die, due to lack of and lack availability to of health monitoring devices and doctors, most of the countries in the world facing this type of problems. There are numbers of the system which can provide remote health care services but there have some limitation such as very costly, lack of patient data security and highly communicational and computational overhead.

According to the World Health Organization, the probability of dying between 15 and 60 years of age in male/female (per1000popula-tion) in India is nearly 250/169. In present years, the chronic diseases and the civilization diseases are introduced in the world, due to the changes in the environment.

IV. ARCHITECTURAL DESIGN



Internal software data structure:

+calculateData():-Once the data is uploaded in system, this operation calculates the desired values to be displayed to the user interface.

+displayGraph():-It displays the calculated data above in the graphical form.

+sendFeedback():-sends the feedback for display to patient.

+login() :- allows user(doctor/patient) to login.

+logout():-user logouts through this operation.

When SQL returns the results of the query sent to it by PHP, the results of the query will be passed back to PHP using the built in data structures.

Global data structure:

Sessions: Sessions are the global data structure which is used for global authentication.

Temporary data structure

We will be using caches saved on the users device to temporarily store the users query entry. It can be used as one data for setting better environment and better performance in the application.

ALGORITHM:

Naive-Bayes Classification Algorithm:-
Bayesian classification provides practical learning algorithms and prior knowledge and observed data can be combined. Bayesian Classification provides a useful perspective for understanding and evaluating many learning algorithms. It calculates explicit probabilities for hypothesis and it is robust to noise in input data.

ADVANTAGE:

Requires a small amount of training data to estimate the parameters

V. CONCLUSIONS

Advances in principled approaches to predictive patient monitoring have been limited by the difficulty of collecting physiological data from a mobile population of patients. This has been demonstrated in the context of our study by the technological and clinical (and, in the U.K., ethical) obstacles that must be overcome. For the 200 patients that were studied, with an average length-of-stay of nine days, the average time that wearable health monitors were worn by was five days. Patient compliance was generally high, with patients being informed of the potential benefits of wearing their sensors, in terms of identifying any deterioration in their condition.
Even so, ECG sensors were deemed to be unacceptably uncomfortable for prolonged wear, such that the sensors had to be removed from the study. While finger-mounted pulse oximeters were more acceptable to patients, the devices were frequently removed and often not returned to the finger. Data dropout was a significant challenge, mainly due to infrastructure problems (interruptions in the hospital wi-fi service) or expired batteries. The ECG sensor had the bare minimum battery life required for use on the ward (at approximately 24 h), such that nurses could change the device once per day. Any shorter battery life would require several changes per day, which is deemed unrealistic for clinical practice. However, the actual quantity of data ultimately collected was large.

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