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An Efficient Healthcare System for Human Activity Monitoring

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ABSTRACT

Wearable technology (wearable gadgets) is a category of technology devices that can be worn by a consumer which consist of monitoring information about health and fitness. Wearable sensors are used to identify particular complications and give predefined solution to protect the human. Currently advances in wearable sensors systems that monitor movement, physiology, and environment, with a focus on applications for Parkinson's disease, diabetes, stroke, and head and neck injuries. This paper discuss recent trends on wearable sensor network in human for indoor and outdoor monitoring with a focus on sudden heart attack, low BP, indoor alarm for mobile message and email, fire alarm for gas cylinder leakage and electric power short circuit by using HM*, IN* and OUT* algorithm.

INTRODUCTION

Wearable sensor includes devices which incorporate small motion sensors to capture photos and co-ordinate with the mobile devices. A sensor network is composed of a huge number of sensor nodes, that are extremely delivered either inside the concept or very nearer to it. Recently human struggling with several unpredicted occurrences similar to sudden fire, heart attack etc., inside and outside of the home.

According to a June 2015 report on disruptive technologies by Mary M. Rodgers (Balash, Y., 2005), the top four technologies likely to have a significant potential economic impact by 2025 are: 1) mobile internet, 2) automation of knowledge work, 3) the internet of things and 4) cloud computing.Ubiquitous healthcare is an upcoming recent technology that uses a large number of environmental and human sensors and actuators to track and develop human physical and mental condition. Tiny sensors take data on almost any physiological behavior that can be used to analyze health problems (Cancela, J., 2014). UbiHVER is a versatile Ubiquitous Healthcare for monitoring both environmental and physical conditions in indoor and outdoor places, by giving voice SMS alert to near by hospital and caregivers.

It creates a scalable event manager i.e., the system will be able to process 1000 request's per second This healthcare systems take advantage of a large number of hardware and software components, including Wireless Body Area Networks (WBANs), mobile devices and wireless cloud services, in order to reach accurate delivery. As outlined by Ogunduyile, *et al*. (2003), a ubiquitous healthcare system must: 1) provide accessibility to several variable services from a healthcare provider 2) be flexible 3) provide security in information exchange 4) enable remote health data acquisition 5) provide personalized service and 6) develop automatic decision making and response for diseased or healthy situations.

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A. Some Of The Key Challenges Research Includes:

• Fusion of multiple sensor information to find out human activity and medical conditions.
• Analysing normal conditions and activity and hence detecting abnormal conditions.
• The environment needed for very large scale monitoring and analysis of medical information and activity of millions of people.
• The need to automatically warn patients, social services, medical service, friends or relatives about the need for conclusion when critical conditions are detected.
• Social, ethical, security and privacy disputes related to subsequent tracking of people, storing and analysing the data and how to verify the safety, security and privacy aspects of the system.

Activities such as human monitoring, physiologic function, and the environmental condition are being carried out in this paper. Even though this paper focuses more on capabilities of technology, human factors are tackled by many researchers, which includes how to reduce the barriers to the meaningful use of technologies, minimizing physical discomfort for long-term monitoring, and addressing social stigma associated with visible monitoring of health. Rather than depending on comprehensive review of wearable sensors, it describes a selection of recent technology advances and applications that highlight the broad potential of these systems to improve healthy and independent living.

B. Wearable Sensors:

Wearable technology is clothing accessories which includes computer and advanced electronic technologies. The model often consists of practical functions and features, but may also have a purely critical or aesthetic agenda. There have been several successful cases where technologies have moved out of the clinic to monitor patients going about their day-to-day life over extended periods. Perhaps the most notable of these is the ECG Holter monitor for detecting arrhythmias (Bonato, P., 2010). Wearable sensor systems are progressively becoming less obtrusive and more powerful, permitting monitoring of patients for longer periods of time in their normal environment. Current commercially available systems are compact, enclosed in durable packaging, and utilize either portable local storage or low-power radios to transmit data to remote servers (Bonato, P., 2010; Buszewski, B., 2007).

The development and refinement of novel fabrication techniques, sustainable power sources, inexpensive storage capacity and more efficient communication strategies are critical to continue this trend towards “wear and forget”. Activity trackers is a Wearable device which set as a model for the domain Internet of Things. They are part of the network of physical objects or "things" embedded with electronics, software, sensors and connectivity to enable objects to exchange data with a manufacturer, operator and/or other connected devices, without the need of human inference (Bauer, S., 2013).

A passive sensor is a device that determine and reply to some type of input from the physical infrastructure (Butte, N.F., 2012).Passive sensor technologies get input data through the detection of vibrations, light, radiation, heat or other phenomena occurring in the subject’s environment. They are different from active sensors, which consist of transmitters that send out a signal, a light wavelength or electrons to be return back off the target, with data often by the sensor upon their reflection.

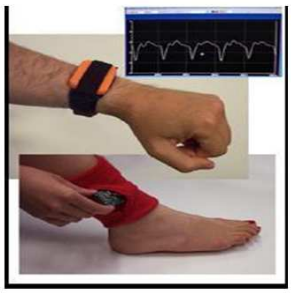

Fig. 1: Wearable Sensors.

Both active and passive sensing technologies are often used to make observations and measurements from a distance or on a point beyond those inferred to the naked eye. Sensors can also be used in hard infrastructures and places inaccessible to human.

Depending on what is being sensed these various sensors might be mounted to a satellite, airplane, boat, submarine UAV drone, or from another convenient point of observation such as a building top. Remote sensing is also one of the basic enabling technologies for the Internet of Things (IoT), in which almost any imaginable entity can be equipped with a unique identifier and the ability to transfer data over a network autonomously.

Applications Of Wearable Sensor Networks:

- Military applications.
- Monitoring friendly forces, equipment and ammunition.
- Reconnaissance of opposing forces and terrain.
- Battlefield surveillance.
- Battle damage assessment.
- Nuclear, biological and chemical attack detection.
- Environmental applications.
- Forest fire detection.
- Bio complexity mapping of the environment.
- Flood detection.
- Precision agriculture.
- Health applications.
- Tele-monitoring of human physiological data.
- Tracking and monitoring patients and doctors inside a hospital.
- Drug administration in hospitals.

II. Activity Recognition:

Activity recognition identify the actions and objectives of one or more agents from a sequence of observations on the environmental conditions and the agents actions (Cancela, J., 2014). This research field has covered the attention of many computer science people due to its potential in providing support for many different uses and its link to many different fields of study such as sociology, human-computer interaction or medicine (Cole, B.T., 2014).

Many different applications in activity recognition like assisting the sick and disabled have been analysed by researchers . For example, Pollack *et al*. show that by automatically tracking human activities, home-based rehabilitation can be provided for people suffering from traumatic brain disorders. Applications can be obtained ranging from security-related applications and logistics support to location-based services. Since it consists of many faces, variety of fields may refer to activity recognition as behaviour recognition, location estimation, plan recognition, goal recognition, intent recognition and location-based services.

Types Of Activity Recognition:

A. Sensor-Based, Single-User Activity Recognition:

Sensor-based activity recognition combines the upcoming area of sensor networks with novel data mining and machine learning techniques to help the human activities in global range. Mobile devices (e.g. smart phones) provide adequate sensor calculation power and data to enable physical activity recognition to provide an determination of the energy intake during day to day life. Researchers think that by depending on ubiquitous computers and sensors to track the characteristics of agents , these computers will perform better.

B. Levels Of Sensor-Based Activity Recognition:

Sensor-based activity recognition is a defiant task because of its inherent noisy nature of the input. Statistical modeling has been considered as the main theme in this view in layers, where the recognition at several intermediate levels is organized. statistical learning deals with how to determine detailed locations of agents from the received data signal at the lowest level (Diamond, D., 2008). Statistics have been concluded by determining how to identify individual actions at the low level and the result obtained is considered as the intermediate level (Cole, B.T., 2014). At the highest level, the aim is to find out the sub goals or overall goals of an agent from the activity sequences.

C. Sensor-Based, Multi-User Activity Recognition:

Multi user activity recognition have been proposed by active badge systems .Acceleration sensors are used for finding out the group activity in office use cases. Multiple Users activity in intelligent infrastructure are studied . The basic problem of recognized activities for multiple users are identified from sensor readings in a home infrastructure, and propose a novel based mining model to identify both single-user and multi-user activities in a integrated solution.

D. Sensor-Based Group Activity Recognition:

Activity recognition in which the aim is to identify the characteristics of the group as an entity, rather than the activities of the individual members within it. (Butte, N.F., 2012) Group characteristic is upcoming technology in nature in which the features of the characteristics of the group are fundamentally unique then the properties of the behaviour of the individuals. (Cancela, J., 2014) The important dispute are in designing the characteristics of the individual people and also the character of the individual within the group dynamic

(Cancela, J., 2013) and their relationship to upcoming technology of the group in parallel. (Che-Chang Yang and Yeh-Liang Hsu, 2010) Risks which must still be studied consist of quantification of the characteristics and roles of individuals who join the group, integration of models which is explicit for role description into inference algorithms, and scalability evaluations for very large groups and crowds.

E. Vision-Based Activity Recognition:

It is an essential and challenging problem to track and understand the behaviour of agents through videos taken by multiple cameras (Duc, C., 2014). The primary technique employed is computer vision. Vision-based activity recognition has found many applications such as user interface design, robot learning, human-computer interaction and surveillance among others. Scientific conferences based on vision based activity recognition work often appear are ICCV and CVPR

Some researchers recently use RGBD cameras like Microsoft Kinect to detect human activities. Extra dimension in depth cameras i.e. Normal 2d camera's depth fails to provide it. Sensory information from these depth cameras have been used to produce real-time skeleton model of different body positions in the humans. This skeleton information provides meaningful information which is to be used to modern human activities by the researchers. This information are trained and later be used to recognize unknown activities .One way to detect specific people is by how they walk. A person's gait or gait profile are recorded by Gait-recognition software in a database for the purpose of recognizing the person later, even if they are wearing a disguise (Konvalina, G. and H. Haick, 2014).

III. Environmental Recognition:

Technology in Quickened developments led to the production of small, low-cost air pollution sensors (Rai, P., 2014). These new technologies, used by industry, academics, individuals and communities symbolize the future of air quality monitoring (Fraser, K.J., 2011). New technologies have the potential to serve multiple purposes, including:

- In-plant sensor networks and "fenceline" monitoring – facilities sensor networks to detect fugitive emissions
- Monitoring near emissions sources – helping communities understand nearby-source exposures
- Wearable sensors – engaging citizens in personal monitoring, and learning about exposures during exposure and the exercise of sensitive family members
- Mobile sensor platforms – developing spatially resolved information on air quality in local areas

Supply current air quality monitoring networks with a high density sensor network.

The Environment Monitoring System (ENVIROMUX Server) monitors critical environmental conditions such as liquid water presence, power, intrusion temperature, smoke and humidity. When a sensor goes out of range of a configurable threshold, the computer system will refer you via LEDs, email, siren, alarm beacon, web page, network management (SNMP), SMS messages (via external GSM) and voice phone calls through Automatic Voice Dialer System (Huang, S., 2012). The system includes three internal sensors: humidity, temperature and power. 16 external configurable sensors and eight digital input sensors are supported by this system.

Manage and monitor server room security and environmental conditions over IP. Alarm signals are created with customized input parameters. Four output relays are used to control the external devices (Jasiewicz, J.M., 2007). Relays activate upon alarm or via the user interface.IP network video cameras are supported for live view of any facility. See different Web cameras side-by-side with environmental and physical parameters in one integrated view. Any programmed event can trigger a snapshot from an IP camera with the USB option (Want, R., 2010). Up to 64 IP network devices are used by the Monitor (ping). Alerts are sent if devices are not responding.

Available sensors include: smoke, temperature, humidity, water, vibration, 4-20 mA converter, voltage detector, glass break, motion etc., System data log stores up to 1,000 event and data entries. Tab-delimited plain text file are downloaded as a log and it is viewed via the web interface or sent up to 16 remote IP addresses using syslog. Log in automatically to USB flash drive w/ USB model.Various Open Source monitoring packages are integrated, for eg.,Nagios and

MRTG. It provides power supply for all sensors. When there is a power outage and power returns, alerts were sent to the particular sensors.

Optional dual power is available for connection to separate two power sources. It is available with optional 48VDC or 24VDC power. Increase the number of sensors connected by using up to six units. Up to six units via Ethernet connection or up to four units using CAT5 expansion cables are connected to increase the number of sensors joined. Single Web interface are used to connect all systems which is available with optional USB port for downloading log data to USB flash drive (Vashist, S.K., 2013).

IV. Proposed System:

In spite of so many recent technology followed in the existing system, there exist some demerits like lack of accuracy, low response, efficiency, less manpower ,mobility are being overcome in the proposed system using HMR (Human Monitoring and Rescue action) methodology.

Algorithm:1-HMR*
Assign S(₱) into C(§)
IF (U == IN ||OUT)
IF (U==OUT)
THEN GOTO OUT*
ELSE
GOTO IN*
ENDIF

HMR* denotes Human Monitoring and Rescue action Algorithm. The algorithm involves assignment of the solution to the problem (S(₱)) into cloud storage(C(§)).Then it checks whether user is in indoor or outdoor. If the result is indoor , IN* algorithm will be executed otherwise OUT* algorithm will be executed.

V.Outdoor Monitoring:

It describes about the sudden health problems like stroke, heart attack etc.,of the human when they are in outdoor. That time, they are helpless. The decider i.e., the human storing some predefined solution for the particular health problem has been loaded in the cloud though the storage devices like floopy disk, pen drive, CD and the communicating devices like computer, mobile and then through antenna .This paper discuss about the wearable sensors through which the condition of that particular person has been sent through voice sms to the nearby hospital. So, here the human plays both the user and the decider role.Figure 2 illustrates that a systems approach is needed to integrate sensors with safe, secure and timely collection, dissemination and interpretation of data related to health status. It also highlights that the role of user and decision-maker may or may not overlap.

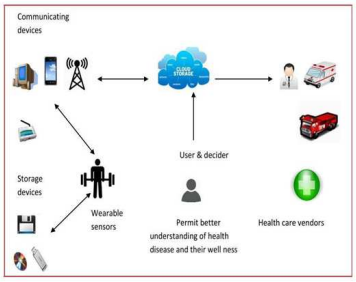

Fig. 2: illustrates the outdoor monitoring of the human.

Algorithm:2 OUT*
SEND ɱ (Outdoor) alert to S
IF Ü ==HA
THEN SEND(HA₱) EMSG to S
ELSE IF Ü==AC
THEN SEND(AC₱) EMSG to S
ELSE IF Ü ==ST
THEN SEND(ST₱) EMSG to S
ELSE IF any other E₱ occur
THEN SEND(ALERT) EMSG to ş
ELSE
NA
ENDIF
END

situations occur, then send emergency message, ”ALERT” to the server.

Immediately relevant rescue actions are taken by the system according to the message received.

A. Medical Scenario:

A Wearable sensor which has a number of medical uses that can significantly influence the management of chronic disease and health hazards[40]. The following scenario illustrate the potential power of wearable sensors for the management of Parkinson’s disease, cardiac diseases, hypo and hyper tension, pregnancy delivery pain,

Diabetes, post-stroke rehabilitation, and the detection/ tracking of head and neck injuries.

B. Parkinson's Disease:

Parkinson's disease (PD), also known as idiopathic or primary Parkinsonism, hypokinetic rigid syndrome, or paralysis agitans, is a degenerative disorder of the central nervous system mainly affecting the motor system (Yang, C.C. and Y.L. Hsu, 2010). The motor symptoms of Parkinson's disease result from the death of dopamine-generating cells in the substantia nigra, a region of the midbrain.

The main motor symptoms are generally grouped and it is called as Parkinsonism, or a "parkinsonian syndrome". This disease are classified as two types ie. primary or secondary. Primary Parkinson's disease is indicate to as idiopathic, although some typical cases have a genetic origin, while secondary Parkinsonism is due to known causes like toxins. All the hazards and protective aspect have been analyzed. The clearest evidence is for an increased risk of PD in people exhibited to certain pesticides and a miniaturized risk in tobacco smokers. The pathology of the disease is represented by the accretion of proteins into Lewy bodies in neurons, and insufficient formation and activity of dopamine in undistributed parts of the midbrain. Where the Lewy bodies are located is often related to the expression and degree of the symptoms of an individual. Diagnosis of ideal cases is mainly based on symptoms, with tests such as Neuro imaging being used for confirmation.

Treatments, typically the antiparkinsonian medications L-DOPA and dopamine agonists, recover the early symptoms of the disease. As the disease growth and dopaminergic neurons continue to be lost, these drugs eventually become ineffective and it produce a complication marked by involuntary writhing movements. Research directions include investigations into new animal models of the disease and of the probable usefulness of gene therapy, stem cell transplants and Neuro protective factor. Medications to treat non-movement-related symptoms of PD, such as sleep disturbances and emotional problems, also exist.

C. Cardiac Disease:

Heart or blood vessels are involved in Cardiovascular disease (CVD) . Cardiovascular disease consists of CAD (coronary artery diseases) such as myocardial infarction (commonly known as a heart attack) and angina (Yeo, W.H., 2013) .Some other coronary artery diseasess are cardiomyopathy, stroke, hypertensive heart disease, atrial fibrillation, congenital heart disease, endocarditis, venous thrombosis aortic aneurysms and peripheral artery disease.

D. Hypo And Hyper Tension:

The low blood pressure, especially in the arteries of the systemic circulation is called Hypotension. The blood pushing against to the walls of the arteries as the heart pumps out blood is called Blood pressure. Hypotension is considered if systolic blood pressure less than 90 millimetres of mercury (mm Hg) or diastolic less than 60 mm Hg.The blood pressure is treated too low only if noticeable symptoms are present.

Hypotension is the opposite of hypertension that is high blood pressure. It is best understood as a physiological state, rather than a disease. It is often corralled with shock, though not irresistibly indicative of it.

Diabetes:

Diabetes mellitus (DM) are basically referred to as diabetes. There are high blood sugar levels over a prolonged period in a group of metabolic diseases (Patel, S., 2010). Frequent urination, increased thirst, and increased hunger are the symptoms of high blood sugar. Diabetes can cause many complications if left untreated. Acute complications include no ketotic hyper osmolar coma and diabetic ketoacidosis. Serious long-term complications include stroke, chronic kidney failure, foot ulcers, cardiovascular disease and damage to the eyes.

Diabetes are caused due to either or the cells of the body not responding properly to the insulin produced or the pancreas not producing enough insulin.

E. Post-Stroke Rehabilitation:

Brain attack, Cerebrovascular insult (CVI) or Cerebrovascular accident (CVA) are commonly known as stoke. It occurs to cell death in the body due to poor blood flow to the brain[30]. Stroke is classified in to two types. hemorrhagic occurs due to bleeding, and due to the lack of blood flow, ischemic occurs. The brain will not function properly as a part. Symptoms and signs of a stroke may include an inability to move or feel on one side of the body, feeling like the loss of vision to one side among others or world is spinning. Symptoms and signs often appear soon after the stroke has occurred. If symptoms last less than one or two hours it is known as a transient ischemic attack (TIA). Severe headache will occur due to Hemorrhagic strokes. The symptoms of a stroke can be permanent long term complications may include pneumonia or loss of bladder control.

VI. Indoor Monitoring:

This diagram describes about the human facing problem when they are in indoor. The human can face electric power short circuit, gas cylinder leakage ,SMS Alert etc., when they are in home. That time the situation ends in danger. So to prevent this type of situation , wearable sensors are used in the human through radio signals to sense these type of problem previously and take some immediate action to avoid the danger.

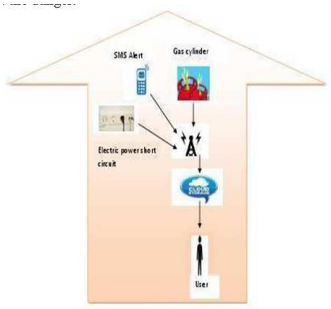

Fig. 3: illustrates the indoor monitoring of the human.

Algorithm:3 IN*
SEND ɱ (Indoor) alert to ʂ IF ₱==GL
THEN SEND(GL₱) EMSG to ʂ ELSE IF ₱==SC
THEN SEND(SC₱) EMSG to ʂ ELSE IF any other E₱ occur
THEN SEND(ALERT) EMSG to ʂ
ELSE
NA
ENDIF

IN* denotes Human Indoor Monitoring Algorithm. The algorithm involves tracking of human indoor activity. Then send SMS i.e., ”IN” (ɱ) to the server (ʂ) .The abnormal conditions(₱) include situations like gas cylinder leakage (GL), short circuit (SC) and other emergency problem(E₱). If the problem is gas cylinder leakage , then emergency message(EMSG) i.e “Gas Cylinder Leakage-

GL₱” is send to the server. If the problem is short circuit , then emergency message i.e “Short Circuit-SC” is send to the server. If any other emergency problems(E₱) other than the above mentioned situations occur , then send emergency message,

”ALERT” to the server. Immediately relevant rescue actions are taken by the system according to the message received.

VII. Overall System Diagram:

System consists of wearable sensor which monitors the human activity and passes an alert message if any emergency situation arises. The system has been divided into two section namely indoor and outdoor. In the indoor section , abnormal conditions like gas cylinder leakage, short circuit, other emergency conditions are handled and the relevant alert messages send to the base station from the mobile networks, then the information is passed to the cloud storage and finally it reaches the corresponding person where the rescue actions will be taken.

In the outdoor section , abnormal conditions like heart attack, accident, stroke, other emergency conditions are handled and the relevant alert messages send to the base station from the mobile networks, then the signal is passed to the cloud storage and finally relevant rescue actions are taken by the system according to the message received.

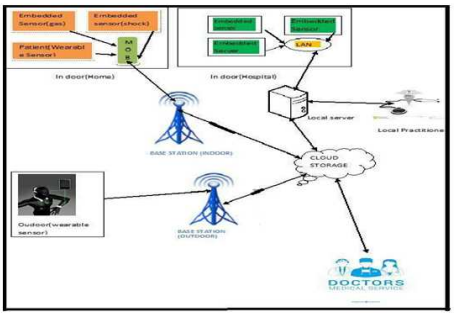

Fig. 4: illustrates overall system.

Conclusion:

Many advanced technology in the field of electronics show excellent work for human activity monitoring. The objective of remote tracking individuals both in the home and outside community can be implemented by unifying wearable technologies and communication technologies. Ambient sensors have been integrated by researchers and scientist when human activity tracking is carried out in the home. In spite of the advancement technology some challenges remain which include efficient energy harvesting, human-device interfacing and improving the quality and range of measurements. The significant need to establish knowledge in the diagnostic capabilities of the system and their capability to modify the result is the unification of different power sources , sensors and testing in a non-controlled human infrastructure. Thus the recent trends on wearable sensor network in human for indoor and outdoor monitoring with a focus on sudden heart attack, low BP, indoor alarm for mobile message and email, fire alarm for gas cylinder leakage and electric power short circuit have been implemented.

Future Directions:

One of the key challenge is the development and optimization of technique is to obtain a high accuracy outcome. Currently, there exist no techniques for mental state such as nervousness, attention span and biochemical status such as hormone levels, assessing pain, immunologic status for monitoring infectious agents and connections with humans. Besides, there exist a need to develop and optimize accurate and sequential physiological monitoring within closed-loop systems. For example, no non-invasive techniques are available to accurately measure the blood glucose which has been limited by the factors such as temperature, metabolic modulators and hydration.

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