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ANALYSIS ON APPLICATION OF IOT IN BIOMEDICAL INSTRUMENTATION

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ABSTRACT

IoT-based biomedical applications are used in biomedical systems such as healthcare, diagnostics, prevention, therapy and monitoring. In addition, healthcare studies are moving toward individualized measurement as a whole. Observed assessments in the laboratory/clinic must be replaced by more comprehensive evaluations. But traditional barriers to long-term free-lived assessment have been the high cost and complexity of equipment. Due to the lack of supervised conditions in free-living assessments, environmental analysis is needed to provide context to individual measurements. Biomedical engineers should be aware of the opportunities, challenges, and limitations presented by low-cost and easily accessible Internet of Things (IoT) technologies. In our biomedical research project, IoT hardware and software technologies have been used to extract quantitative data for comparison with cloud-based cognitive information. A custom interface shows patient-specific information, pathology details and user interaction results to increase the user experience.

INTRODUCTION

A major contributor to revenue and employment, the healthcare industry has seen rapid growth in recent years [1]. A few years ago, the only way to diagnose diseases and abnormalities in the human body was to undergo a physical examination in a hospital setting. They had to be hospitalised for a large portion of their treatment. In rural and remote areas, this resulted in higher healthcare costs, as well as a strain on healthcare facilities. Technological developments have made it possible in recent years to diagnose different diseases and to monitor health using miniaturised devices such as smart watches.

The Internet of Things has broadened human interactions with the external environment, in addition to improving human independence. The Internet of Things has made a significant contribution to global communication and information exchange through futuristic protocols and algorithms. A large number of devices are connected to the Internet[4]. In agriculture (5), automobiles (6), household (8) and medical services ((1) the Internet of Things (IoT) applications can be used. The internet of things is becoming increasingly popular because of its ability to predict future events more precisely. Increased knowledge of software and apps, improvements to mobile and computer technology, easily accessible wireless technology and the increasing digital economy have also helped contribute to a rapid IoT revolution[10]. A number of communication protocols have been applied, for example, to monitor and exchange information between IoT devices (sensors and actuators) and other physical devices, including Bluetooth, Zigbees and IEEE 802.11 (Wi-Fi).

In order to coordinate their decisions, physical objects/dispositions can view, hear and think with each other by sharing the information (IoT). Traditional objects are becoming clever by using the underlying technologies such as embedded devices, communication protocols, sensor networks and Internet protocols [2].

Remote monitoring systems, for example, are widely used in the security industries for power plants, OBDII readers and pacemaker interfaces [2] and [3]. This market seeks to increase the ability of consumers to interact in ways that enable them to make informed decisions, such as using FitBit to measure performance at an event or the general health of an individual, from monitoring system component systems (e.g. NEST home environmental system monitoring) to compare their personal health data with other users.

Most of today's hardware solutions and open source environments are readily available, making it easier for professionals and academics to better understand how these systems work together. A new generation of IoT solutions can now be applied to previously untested problems thanks to the availability of tools and knowledge. For example, the acceptance of new methods of technological integration is driven by conceptual research and application development, as shown with off-the-shelf microcontrollers [5]. In 2020, McKinsey & Company Managing Director Harald Bauer predicts that more than 30 billion IoT infrastructure supported devices will drive the growth in the semiconductor industry[6].

1. LITERATURE REVIEW

This was a comprehensive study of "IoT" that took into account all of the interrelationships and constraints involved. The primary goals of "IoT" are to send and receive Internet-based communications and information. "28.4 trillion IoT users and 50.1 trillion by 2020" according to a report The Internet of Things offers a large range of services, according to scientists. There is continuity of contact with the use of "Wi-Fi, mobile phone, NFC, GPS etc." In contrast to the development of software, IoT's main objective is to integrate organisations, mechanisation in order to transmit message without interruptions. Compression-embedding camps such as the MCUS, MPUs are used to initiate the programming on most frequently recycled sensors with accelerometers.

Intelligent fitness, transportation, grids, parking, and intelligent homes have all benefited from the services. This means that IoT's primary goal is combining organisations and automation in order to provide messages on a continual basis Compared to software development as a whole, the "IoT phase" is divided into "criteria, specifications, and implementation." A crucial method is the final section of the company process. "H." In order to better understand the requirements of any IoT project during the design phase, Eskelinen asked two questions. In this respect, a strategy that combines realistic aims and theory, taking into consideration that real life is a research centre, needs to be developed before building is funded. Testing techniques should be used professionally and systematically.

There is no doubt that the WSN plays an important role in the Internet of Things, especially when it comes to the healthcare applications of IoT. High-end and a wide range of other wireless control systems are what they're known for over other regular devices. In 2012, Rotariu and Manta emphasised the importance of developing a WSN for pulse rates and oxygen saturation. In 2016 Yuehong et. al. mounted ECG and blood pressure sensors on mobile telephones.

Del Din S, 2016, there is a trend towards personalised medicines with measures that are appropriate for the problems or needs of individuals. Health biomarkers could be better identified with the help of individualised measurements [9]. It is necessary for researchers to move beyond the laboratory and into real-life assessment in order to conduct such assessments in the future. When patients are assessed over time in their normal environments, the measurements become more variable, which can help distinguish between physiological conditions.

2. ARCHITECTURE OF HEALTHCARE IOT (HIOT)

For healthcare applications, the IoT framework allows the advantages of IoT technology and cloud computing to be integrated into the medical field of practise. There are protocols for transmitting patient data from a variety of sensors and medical devices to a specific healthcare network. IoT healthcare system/network topology refers to how a system/component network's parts are organised and connected in a coherent manner in a healthcare environment. Publisher, broker, and subscriber are the three main components of an HIoT system (Figure 1).

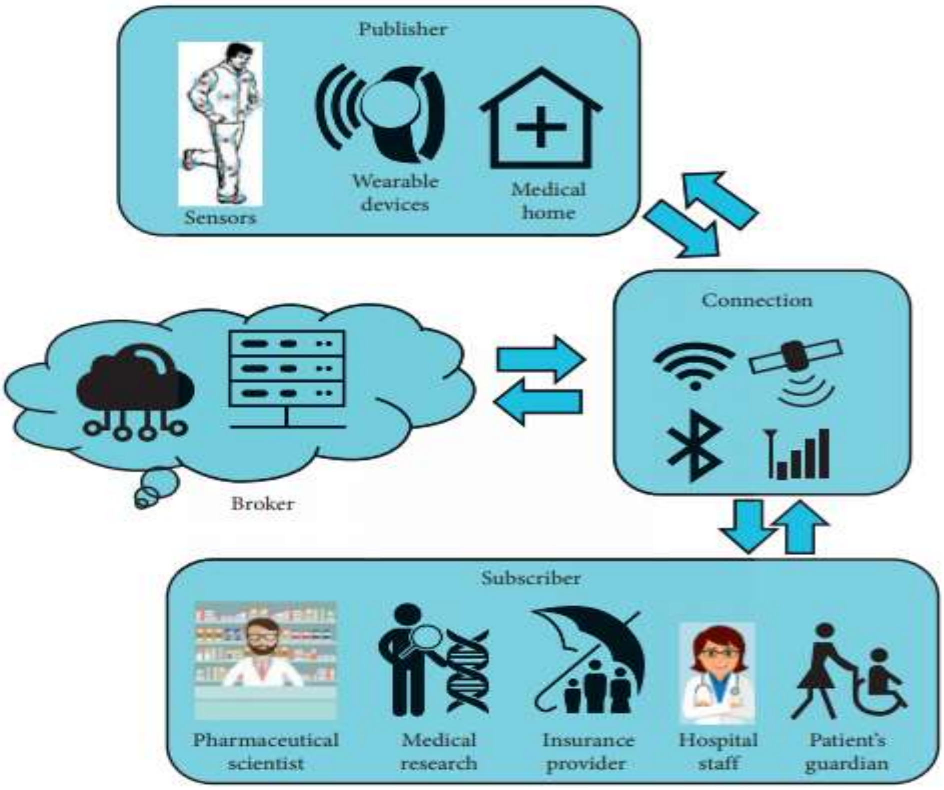

Figure 1: HIoT Framework Architecture (reproduced from under Creative Commons License).

The publisher is a network of connected sensors and other medical equipment that can record essential information individually or simultaneously for patients. This may include blood pressure, heart speed, temperature, oxygen saturation, ECG, EEG, eMG etc. This information is not accepted. The publisher can send this information continually to the broker via a network. The broker handles the acquired data and stores them in the cloud. Finally, the subscriber enable the patient's information to be continuously monitored and visualised via smart phone, computer, tablet, etc.

3.1 The Architecture of IoT in HealthCare

IoT is a network of devices linked by physical objects that can listen to, analyse and monitor remote devices. The mechanism of the computer connection allows communication between sensors and smart sewing devices. In IoT data processing, IoT implementation is strongly based on the middleware layer. The other IoT systems are: smart grid, smart town, smart home, smart farming... The architecture of IoT is based on three levels of understanding and networking. Further expansion of middleware and company applications.

1. Perception layer: Sensory and physical instruments are recognised in the cognitive layer. The sensor layer system points to an object and detects it and collects object information. The sensors can collect information concerning temperature, movement, humidity, vibrations, distances, speeds, chemical changes, etc. The information is transmitted to the following layer of treatment. When a lady is wearing clean earrings that help her to diagnose various organs and gain a position for women? Data from the node is transmitted by the viewing layer to the network layer.

2. Perception Layer: The main objective is to connect various waiters, intelligent objects and network devices, often known as the "Broadcast Layer." Collect sensor transmission data on sensor equipment. Communication technology can be used by Infrared, Bluetooth, ZigBee, Wi-Fi, UMTS and 3G. The core information will then be moved to a middleware layer after network layer coating, which transfers the information to the front of the working layer from the core.

3. Middle wave Layer: The large processing layer that stores it experiences the huge amount of data obtained from the network layer. Communication of the data base and management of resources is responsible because it is in the middle layer and provides a service layer for the lower layers. It is linked with Big Data and cloud computing for processing large amounts of data. The analysis and control of body temperature on earrings data is performed. Where the average temperature differs, in an industry that is reliable and similar to the customer.

4. Application Layer: The provision of application-orienteered services to end users is an important aspect of this layer. This is because the layer explicitly interacts with the end user via application layers. After receiving the information on the earrings of a lady, tell her that you have fever and can contact the lady on a request form. The flu message is sent on the phone and it is a communication layer with the user.

5. Business Layer: The entire business model of IoT is controlled by the corporate layer. This makes it more efficient for users to decide. For instance, in your nearest clinic or hospital a person with fever will suggest details.

4. EXPERIMENTAL CASE STUDY: TOWARDS HOLISTIC IOT-BASED REMOTE MONITORING

We conduct experiments on how biotechnology experts can use the vast variety of IoT technologies covered in our work to implement current approaches to remote environments and to monitor physiology. Here we look to a cost effective IoT approach to holistically track a person at home, focusing on the gait/walking evaluation. The latter is often called the sixth key sign and is becoming increasingly important because of its ability to provide pragmatic insights into neurological conditions like PD. A conceptual gait model, in conclusion, suggests that many spatial and temporal characteristics (for example, step duration, step time variability) are clinically useful for the initiation and development of PD.

This is important because the diagnosis, treatment and management of PD patients may involve an observational gait test. In the clinic, gas testing has traditionally proved helpful, but it is limited because the environment does not reflect everyday life (e.g. good lights, no barriers). A methodological change has been introduced by advances in wearable technology to quantify the characteristics of space and time-guess outside the clinic. These features of free living are assumed to provide a greater insight, as they are usually generated. Evidence to date indicates that different types of habitual gait exist in comparison with the clinic with remarkable insights into the reduction of the risk during the long evaluation of patients with PD.

Current state-of-the-art longitudinal remote gait assessments are mainly based on a lower back of the inertial device for longer periods (typical three axiales) (up to 7-days when also considering ambulatory behaviours). The wearable is picked up in person or returned to the researcher after the recording is completed. This is very ineffective, expensive and often can lead to wearables being damaged (or lost) (and data). Moreover, due to insulating requirements for persons with medical conditions, the recent COVID effect of the 2020 pandemic put an end to clinical and research studies in this area.

Exploring IoT approaches to remote assessment

In experiments with IoT and algorithm deployment, biomedical engineers can use methods which are a continuum of existing and validated approaches. TingSpeak is a Matlab-built open-source cloud platform, allowing it to execute its cloud code to analyse and view IoT data streams in real time.

Experimental setup and equipment

In order to test the viability of TingSpeak in gait analyses and compare Matlab with TingSpeak, we conducted an experimental study. For our experimental research, we provide AX3 data from a single user in their usual environment. The participant was worn for 1 hour, free of charge for normal work, on the bottom of his back, one AX3 (100 Hz/8 g). The Research Ethics

Committee of the University of Northumbria (REF: 16,335/335) gave ethical authorisation. The participant gave informed written consent before taking part in the study.

Fig. 2 The light intensity data logger of the MX1101 is connected to the ESP32 development panel and the ambient light sensor BH1750.

While it is one of the key advantages to TingSpeak to run Matlab code in cloud, the platform also offers supported integration and code libraries in Arduino-based devices. We also have used a low cost MEMS light intensity sensor (BH1750) to collect and transmit information to TingSpeak every 5 minutes using the development board Heltec ESp32 Wi-Fi 32, to test the possibility of using this platform to enhance wearable sensor data by means of environmental data (Fig. 2). The frequency of data transmission matched the light-intensity data logger HOBO MX1101 which recorded local storage data to simultaneously validate BH 1750. For 5 days consecutively, data was collected from both devices.

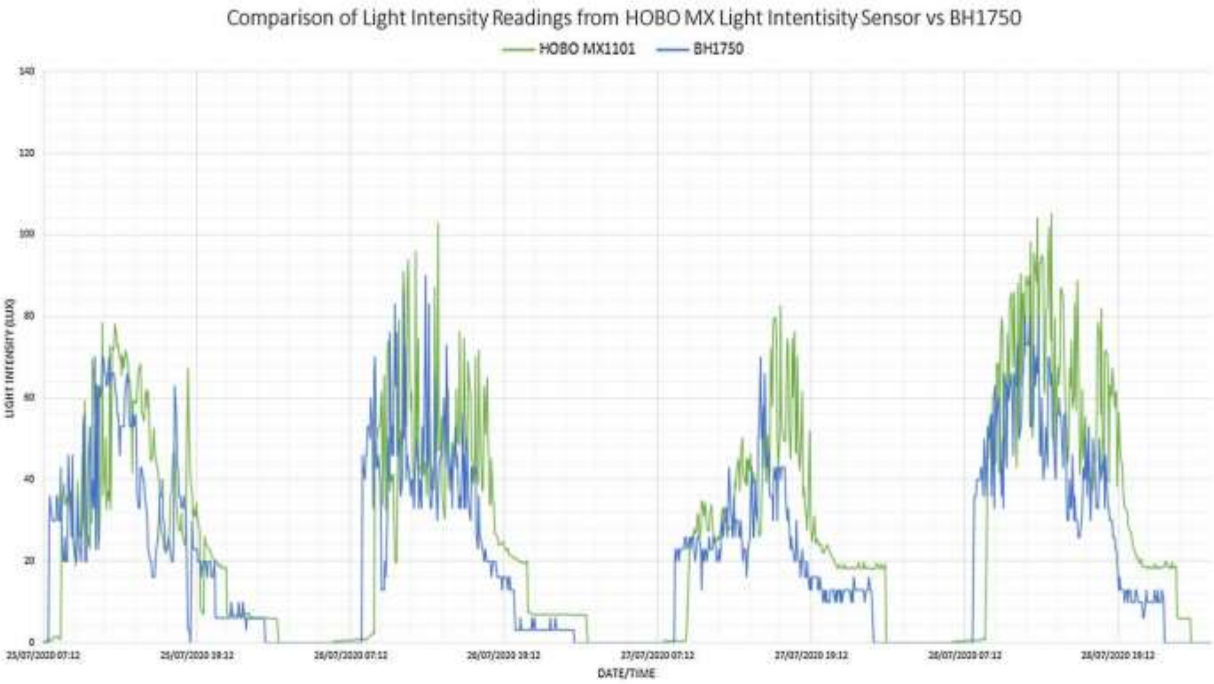

Fig. 3 Data captured from HOBO MX1101 and BH1750

With regard to data validation, a highly correlative BH 1750 with a Pearson correlation of 0.799 was shown to be the HOBO MX1101 sensor. Fig. 3 further illustrates how BH1750 reacts better to the change in luminous intensity, while its exactness is slightly smaller than that of the MX1101. The results show the potentially low-cost MEMS light sensors for the measurement of ambient light intensity.

Gait: high-frequency data

The successful collection and download of individualised gait data via a usual desktop approach has been achieved. Each exit was tested for initial and last time contacts and spatial and temporal results (Table 1) were previously presented and successfully segmented and identified gait events (Fig.4).

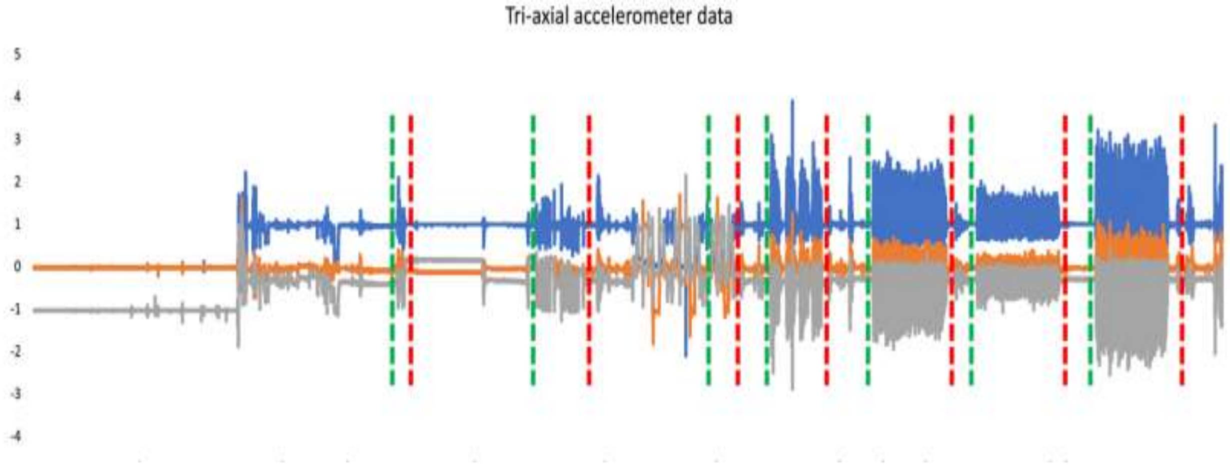

Fig. 4 Triaxial accelerometer data free-living (AX3). The green and red vertical indicate possible start/stop markings.

Table 1: Individualised gait outcomes from all free-living data.

Gait characteristics	Mean values across many bouts (s)
Step time	0.541
Stance time	0.711
Swing time	0.489
Step length	0.689
Step velocity	1.276

In contrast, while TingSpeak could collect, store, view and analyse data from low-frequency sensors, it was found that it could be used for current IoT-based Gait evaluation approaches. Although the imposed rate limit allows up to 14,400 readings every 15 s, the platform is able to handle high-frequency data using similar desktop approaches. During the bulk update however, TingSpeak will check the timestamp of each reading for no duplicate rows.

CONCLUSION

This article defines IoT as one of the most important IoT applications as the main distributor of health systems. helps to provide health care to people in any region at any time by removing geographical, temporary and other obstacles while simultaneously improving their coverage and efficiency. The IoT health revolution offers high-quality care for people, which is true and therefore fair and affordable. Such applications generate large volumes of sensor data to manage and monitor properly. Given the overall phenomenon of IoT technology, health care rely on multidisciplinary research teams to break these disturbing technologies. Therefore, the knowledge of the core concepts of IoT technology is important for biomedical engineers to be more aware of these technologies' technological capabilities and challenges. This will better position biomedical engineers not only to conduct research but also to monitor progress during the technology of biomedical in their investigation.

REFERENCES

[1] Sosa, J. , Bowman, H., Tielsch, J., Powe, N., Gordon, T., and Udelsman, R., 1998, "The Importance of Surgeon E xperience for Clinical and Economic Outcomes From Thyroidectomy," Annals of Surgery, Volume 228, Number 3, pp. 320330.

[2] Sung, W. and Chiang, Y., 2012, "Improved Particle Swarm Optimization Algorithm for Android Medical Care IOT using Modified Parameters," Journal of Medical Systems, Volume 36, Issue 6, pp. 3755–3763.

[3] Hassanalieragh, M., Page, A., Soyata, T, Sharma, G., Aktas, M., Mateos, G., Kantarci, B., and Andreescu, S., 2015, "Health Monitoring and Management Using InternetofThings (IoT) Sensing with Cloud-Based Processing: Opportunities and Challenges," IEEE Xplore, pp. 285291.

[4] Takacs, J., Pollock, C., Guenther, J., Bahar, M., Napier, C., and Hunt, M, 2014, "Validation of the Fitbit One activ ity monitor device during treadmill walking," Journal of Science and Medicine in Sport, Volume 17 Issue 5, pp. 4 96500.

[5] Fuentes, M., Vivar, M., Burgos, J., Aguilera, J., and Vacas, J., 2014, " Design of an accurate, low-cost autonomous data logger for PV system monitoring using Arduino™ that complies with IEC standards," Scienc e Direct Elsevier, Volume 130, pp. 529543.

[6] Bauer, H., Patel, M., and Veira, J., 2014, "The Internet of Things: Sizing up the opportunity," from http://www.mck insey.com/industries/hightech/ourinsights/theinternetofthingssizinguptheopportunity

[7] Moorthy, K., Munz, Y., Sarker, S., and Darzi, A., 2014, "Objective assessment of technical skills in surgery," BMJ, Volume 327, pp.10321037.

[8] Kanis, J., 2007, "Assessment of Osteoporosis at the Primary Healthcare Level," WHO Scientific Group Technical R eport, The University of Sheffield, pp. 1339.

[9] Hak, D., Wu, H., Dou, C., Mauffrey, C., and Stahel, P., 2015, "Challenges in Subtrochanteric Femur Fracture Mana gement," Orthopedics, Volume 38, Issue 8, pp. 498502.

[10] Wani, M., Wani, M., Sultan, A., Dar, T., 2009, "Subtrochanteric Fractures-
Current Management Options,“ The Internet Journal of Orthopedic Surgery, Volume 17, Issue 2, pp. 18.