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Smart Health Care Kit based on IoT

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Abstract—the past few years have witnessed an increase in the development of wearable sensors for health monitoring systems. This increase has been due to several factors such as development in sensor technology as well as directed efforts on political and stakeholder levels to promote projects, which address the need for providing new methods for care given increasing challenges with an aging population. An important aspect of study in such system is how the data is treated and processed.This project provides a recent review of the latest methods and algorithms used to analyze data from wearable sensors used for physiological monitoring of vital signs in healthcare services. In particular, the project outlines the more common data mining tasks that have been applied such as anomaly detection, prediction and decision-making when considering in particular continuous time series measurements.

Keywords—Wearable sensor,IoT,Health Monitoring, Raspberry Pi, Healthcare Kit, Blynk software, ADC, ECG, Pulse

I. INTRODUCTION

With the increase of healthcare services in non-clinical environments using vital signs provided by wearable sensors, the need to mine and process the physiological measurements is growing significantly. Moreover, recent advances in data mining for health monitoring systems have led to provide proactive information. In the literature much attention has been given to sensor development and architectures for wearable sensors [2–5]. Today, there are several reviews on the topic which provide an overview of the current state of the art [6–9]. More specifically these reviews contribute with a general and global overview of wearable sensors and their relevance to biomedicine, medical informatics, and ambient assisted living (AAL) [10–12]. However, as the field progresses and more works consider deployment in real settings, data mining techniques that consider the specific challenges which emerge from data coming from wearable sensors is of ever increasing importance. In health monitoring systems focus has been recently shifting from that of obtaining data to one of developing intelligent algorithms to perform a variety of the tasks [12]. Such tasks not only include traditional pattern recognition and anomaly detection but also must consider decision based systems which can handle context awareness, and subject specific models and personalization. These latter challenges are particularly important if health monitoring services are to be designed that can address the growing market needs and opportunities in pervasive sensing such as distributed health monitoring and long-term prevention. This paper attempts to clarify how certain data mining methods have been applied in the literature. It also attempts to reveal trends in the selection of the data processing methods based on the requirements of the monitoring system. For this reason, the paper focuses on reviewing the data mining and pattern recognition methods used in the literature for applications involving wearable sensing technologies. Focus is put on the algorithms and data sets that have been used in order to provide an overview of the algorithm's capabilities and shortcomings.

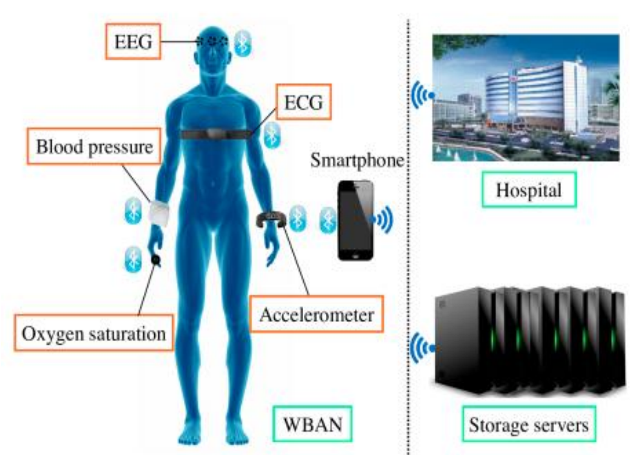

Figure.1 Health Monitoring system

The purpose of the contribution statement In this paper, a comprehensive survey on the current state-of-the-art in research and development of wearable low-cost unobtrusive systems for health-monitoring is presented.

1. A variety of system implementations either for general purpose or even for application specific health monitoring are re-viewed in order to identify current technological achievements, potentials and shortcomings as well;
2. The measurement of these vital bio-signals and their subsequent processing for feature extraction, leads to a collection of real-time gathered physiological parameters, which can give an overall estimation of the user's health condition at any given time.and
3. Emerging technologies such as IoT and cloud-based machine learning have opened the door for vast improvements to personalized health care. However, we must understand the strengths and limitations of each technology to assemble a system that is reliable, practical, and provides the best possible support to both doctors and patients.

The remaining part of this paper is organized as follows, Section I contains the introduction of Importance of IoT based Health monitoring sensors , Section II contains the related work of previous surveys and research, Section III contains some of the exclusive sensors and their corresponding measured physiological signals that can be integrated as a part of health monitoring systems, Section IV contains the architecture and essential steps of the front end and the backend deployment of the health monitoring system which is necessary for the secure acquisition of the patient health data, section V explains the study area and methodology with flow chart and system composition, Section VI describes the expected results and discussions, Section VII concludes research work with future directions.

II. Related Work

In Coeey's smart health monitoring systems, Bluetooth entitled devices were used to let the users automatically log their medical data.It took note of their health by using the medical records for storing, analyzing and sharing with health institutions.Apart from this, it advises the users on smart health tips and some services depending on the analysis of the parameters acquired.The person under monitor need not visit pharma, lab or hospitals, since the facility of remote monitoring of health reports gives the option of connecting the patient remotely with all the mentioned health service providers.More importantly, it gives emergency messages and alerts to the concerned care-takers about any risks in the health.This smart health care solution mainly targets chronic patient with tie-ups along with third party vendors. It provides mobile-assist with mobile APIs, smart assist for tips and W-Assist for web based portals that are connected to the internet.

Microsoft Health Vault is one more solution of smart health monitoring system that takes care of capturing, using and storing the data. This data is made available online for any reference during emergencies. The previously stored data is frequently compared with the new data to give updates on health conditions and if necessary, alerts the patients for any irregular behavior in the data. The main features of Microsoft Health Vault apart from authentication and authorization include user-control to share their data and Data Provenance to take decisions on how data from different sources are to be organized

III. Methodology

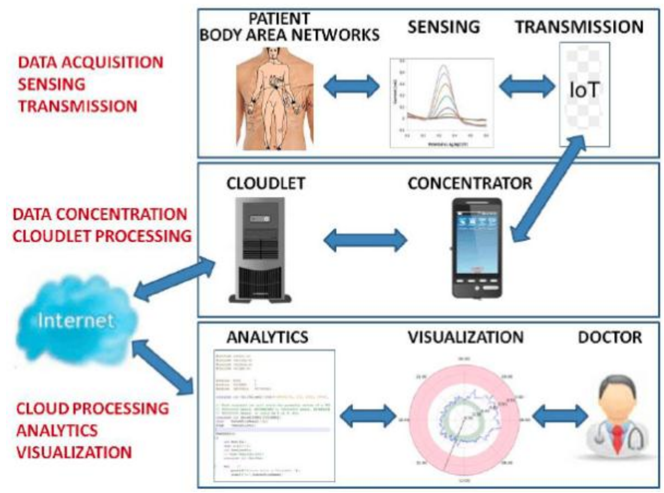

Figure.2 Health Monitoring using IoT

Our proposed methodology includes a smart Health Care Kit that acquires a patient's data automatically and through IoT collects these parameters through various health monitoring sensors like:

- ✓ **Pulse monitoring device**: This device is used to monitor the pulse of a person and is connected to the channel-1 of ADC and the resulting digital output is given to the Raspberry Pi.
- ✓ **ECG**: This device is used to measure the heart beat pattern of a person and is connected to the channel-2 of ADC and the resulting digital output is given to the Raspberry Pi.
- ✓ **HT**: This device is used to measure the humidity and temperature of a patient and is connected to the channel-3 of ADC and the resulting digital output is given to the Raspberry Pi.

The Raspberry Pi output is then processed and uploaded to the cloud infrastructure through the Blynk software and made available for the hospitals, doctors and other stake-holders for further analysis and storage using IoT technology.

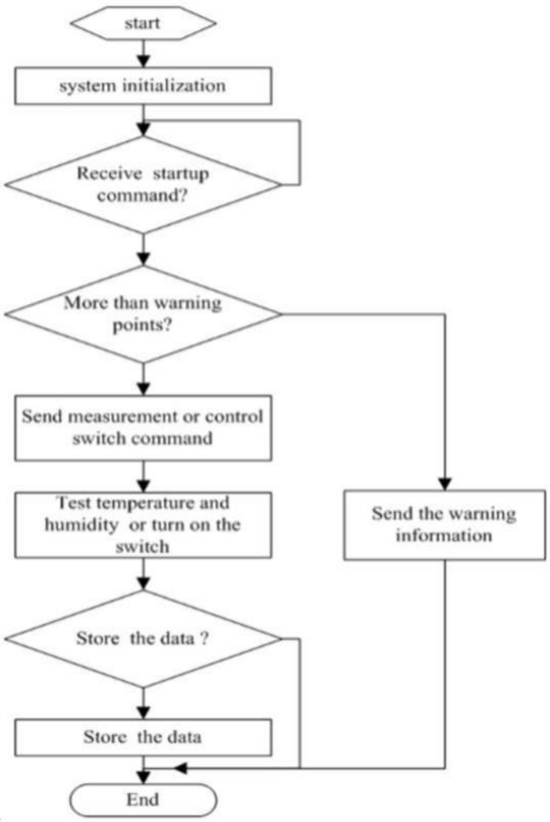

Figure. 3 Flow chart showing the acquisition of Temperature and Humidity readings flow chart using a HT Sensor

Hardware Description:

1. **Pulse Sensor (SCN11574):** This sensor is used to monitor real-time heart rate of a person by clipping on to a fingertip or earlobe. It is a plug and play device specially designed for Adruino (RPi).

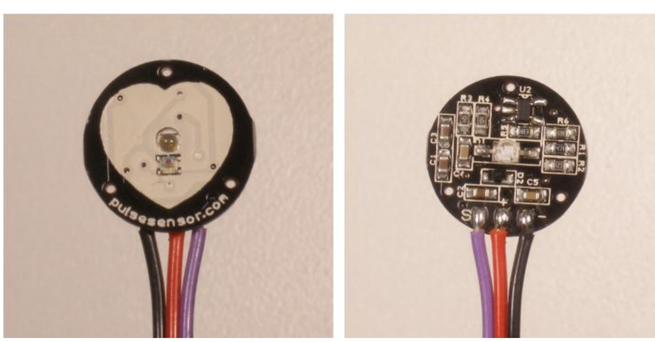

Figure.4 Pulse Sensor SCN11574

The output of the device can be directly connected to an Adruino using jumper cables. The front side of the device has the sensor and makes direct contact with the skin of the finger. There is also an LED which shines from the back and a small square just under it.This square is an ambient light sensor just like the one used in cellphones. The LED shines and lights the fingertip or earlobe so that the sensor reads the light that is reflected back. The rest of the hardware circuit is located in the back of the device so that, they do not interfere while sensor reads the light signals. There are 3 main terminals in the device connected to the adruino using jumper cables as follows:

a. **Red:** +3V to +5V for power supply
b. **Black:**for grounding
c. **Purple:**Signal output

2. **ECG Sensor (AD8232):** This is a sensor used to measure ElectroCardio Gram activity of a person. The AD8232 is an integrated front end for signal conditioning of cardiac bio potentials for heart rate monitoring.The main components of the sensor include instrumentationamplifier (IA), an operational amplifier (A1), a right leg drive amplifier (A2) and a midsupply reference buffer (A3). It also includes leads off detection circuitry and an automatic fast restore circuit that brings back the signal shortly after the leads are reconnected. The instrumentation amplifier amplifies the ECG signal and rejects the electrode half-cell potential on the same stage. This is possible with an indirect current feedback architecture that reduces the size and power compared with legacy implementations.

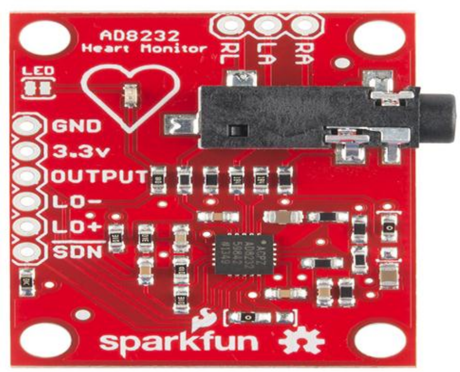

Figure.5 ECG Sensor AD8232

a. **Pin 17:** 3.3V to 5 V DC
b. **Pin 10:** Signal Output.
c. **Pin 16:** For Grounding

3. **Humidity and Temperature Sensor (HT11):** This device is a sensor used to measure the Humidity and Temperature parameters of a person. The main components of the sensor include a component for resistive-type humidity measurement and a component for NTC temperature measurement. It also connects to a high-performance 8-bit microcontroller, offering

excellent quality, fast response, anti-interference ability and cost-effectiveness.The component is 4-pin single row pin package.

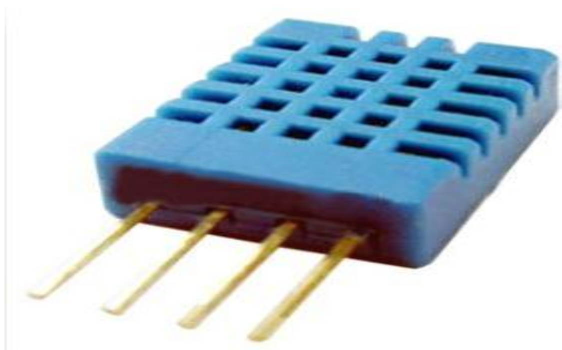

Figure.6 Humidity and Temperature Sensor HT11

a. **Pin 1:** 3.5V to 5 V DC
b. **Pin 2:** Signal output
c. **Pin 4:** For Grounding

Analog to Digital Converter (ADC 1115): ADS1115 is a precision analog-to-digital converter (ADC) with 16 bits of resolution. Data are transferred via serial interface and four I2C slave addresses can be selected. The ADS1115 operate from a single power supply ranging from 2 V to 5.5 V. It features an input multiplexer (MUX) that provides two differential or four single-ended inputs.The ADS1115 operates either in continuous conversion mode or a single-shot mode that automatically powers down after a conversion and greatly reduces current consumption during idle periods. The operating temperature range is between –40°C to +125°C.

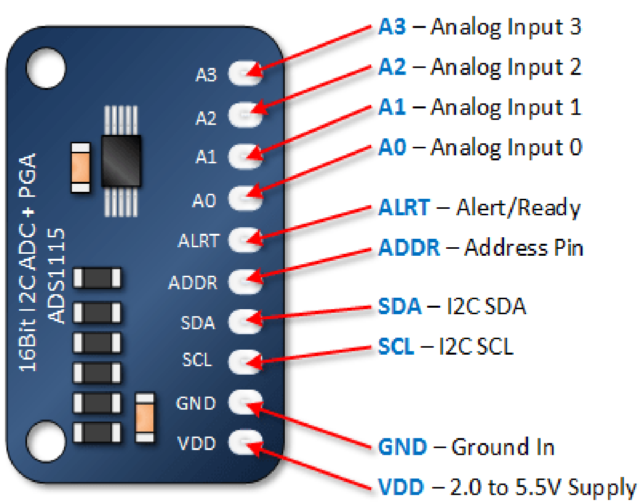

Figure.7 ADC 1115 pins information

a. **Pin 8:** VDD 2.0V to 5 V DC power supply
b. **Pin 9:** Transmits and receives serial data
c. **Pins 4 to 7:** Analog inputs AIN0 to AIN3
d. **Pin 3:** Grounding
e. **Pin 2 :** Digital output, Comparator output or conversion ready

Raspberry Pi (Model B+): This is a single board processor without any peripherals used for small computational and processing tasks. The Raspberry Pi 3 Model B+ has a 64-bit quad core processor running at 1.4GHz, dual-band 2.4GHz and 5GHz wireless LAN, Bluetooth 4.2/BLE, faster Ethernet, and PoE capability The dual-band wireless LAN comes with modular compliance certification, allowing the board to be designed into end products with significantly reduced wireless LAN compliance testing, improving both cost and time to market.

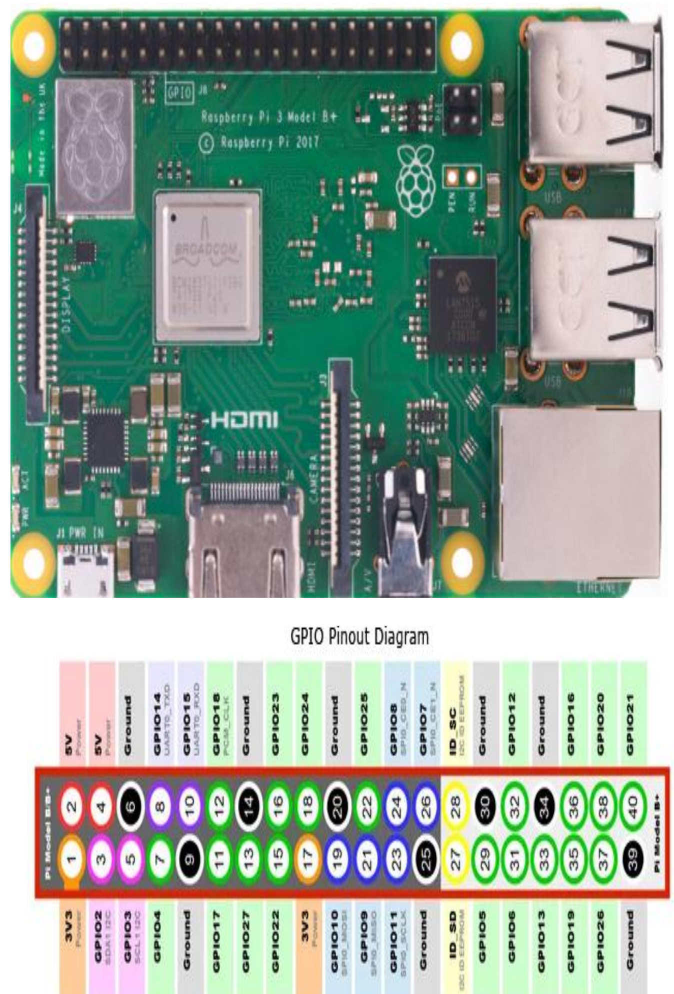

Figure.8 Raspberry Pi Architecture and Pin Out Diagram

a. **GPIO:** General Purpose Input and output pins
b. **Ground:** Ground Pins
c. **Power supply:** 3.3V
d. **Power supply:** 5V

IV. RESULTS AND DISCUSSIONS

Following are the results obtained for different sensors measured for a particular person in real-time.

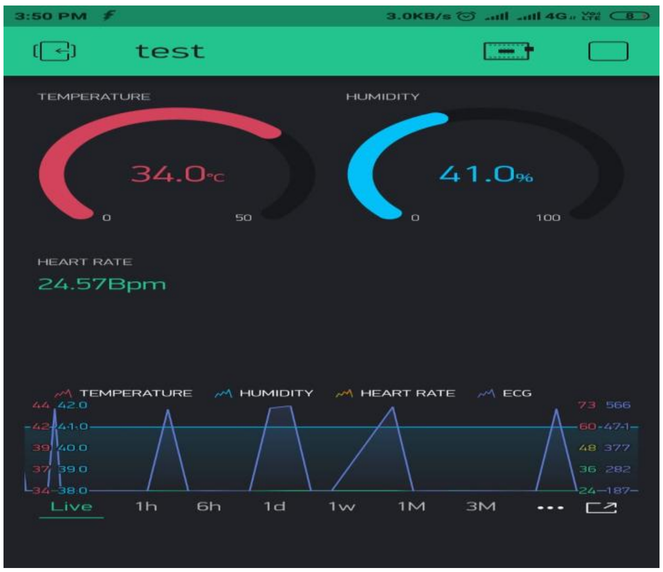

Figure.9 Output of sensors displayed in Blynk software

With the results from Fig 7, that were collected, we were able to log the results in the cloud using Blynk software with respect to temperature, humidity, heart rate and ECG.

Figure.10 Graph of various health parameters

The output in the form of graphs from the Fig 8 shows the pattern and behavior of the different vitals that can be monitored for any irregularities in the health parameters.

V. CONCLUSION AND FUTURE SCOPE

With the above proposed system, we were able to analyse different healthy/normal and non-healthy/abnormal body parameters and upload theses parameters to cloud using IoT technology. In future, we should be able to add more vital parameters and making the data available to all the stake-holders into the cloud infrastructure using IoT. There might be some limitations because of the number of channels currently used in the ADC.

REFERENCES

[1] Sow, D.; Turaga, D.; Schmidt, M. Mining of Sensor Data in Healthcare: A Survey. In Managing and Mining Sensor Data; Aggarwal, C.C., Ed.; Springer: Berlin, Germany, 2013; pp. 459–504.

[2] Suh, M.K.; Chen, C.A.; Woodbridge, J.; Tu, M.; Kim, J.; Nahapetian, A.; Evangelista, L.; Sarrafzadeh, M. A remote patient monitoring system for congestive heart failure. J. Med. Syst. 2011, 35, 1165–1179.

[3] Youm, S.; Lee, G.; Park, S.; Zhu, W. Development of remote healthcare system for measuring and promoting healthy lifestyle. Expert Syst. Appl. 2011, 38, 2828–2834.

[4] Malhi, K.; Mukhopadhyay, S.C.; Schnepper, J.; Haefke, M.; Ewald, H. A Zigbee-based wearable physiological parameters monitoring system. IEEE Sens. J. 2012, 12, 423–430.

[5] Yamada, I.; Lopez, G. Wearable Sensing Systems for Healthcare Monitoring. In Proceedings of the Symposium on VLSI Technology, Honolulu, HI, USA, 12–14 June 2012; pp. 5–10.

[6] Chen, M.; Gonzalez, S.; Vasilakos, A.; Cao, H.; Leung, V.C. Body area networks: A survey. Mob. Netw. Appl. 2011, 16, 171–193.

[7] Custodio, V.; Herrera, F.J.; Lopez, G.; Moreno, J.I. A review on architectures and ´ communications technologies for wearable health-monitoring systems. Sensors 2012, 12, 13907–13946.

[8] Pantelopoulos, A.; Bourbakis, N.G. A survey on wearable sensor-based systems for health monitoring and prognosis. Trans. Syst. Man Cyber. Part C 2010, 40, 1–12.

[9] Alemdar, H.; Ersoy, C. Wireless sensor networks for healthcare: A survey. Comput. Netw. 2010, 54, 2688–2710.

[10] Baig, M.; Gholamhosseini, H. Smart health monitoring systems: An overview of design and modeling. J. Med. Syst. 2013, 37, 1–14.

[11] Rashidi, P.; Mihailidis, A. A survey on ambient-assisted living tools for older adults. IEEE J. Biomed. Health Inform. 2013, 17, 579–590.

[12] Atallah, L.; Lo, B.; Yang, G.Z. Can pervasive sensing address current challenges in global healthcare? J. Epidemiol. Glob. Health 2012, 2, 1–13. 13. Lara, O.D.; Labrador, M.A. A survey on ambient-assisted.

[13] K.A. Townsend, J.W. Haslett, T.K.K. Tsang, M.N. El-Gamal, K. Iniewski, ‚Recent Advances and Future Trends in low power wireless systems for medical applications', in Proc. 5th Intl. Conf. Work-shop on System-on-Chip for Real-Time Applications, 2005, pp. 476-481.

[14] S.L.P. Tang, ‚Recent developments in flexible wearable electronics for monitoring applications',

[15] Trans. Of the Inst. Of Measurement and Control, Vol. 29, pp. 283-300, 2007.
[16] Bluetooth. (2009, 9 October). [Online]. Available: www.bluetooth.com
[17] Zigbee Alliance. (2009, 9 October). [Online]. Available: www.zigbee.orG
[18] M.R. Yuce, S.W.P. Ng, N.L. Myo, C.H. Lee, J.Y. Khan, W. Liu, ‚A MICS Band Wireless Body Sensor Network', in Proc. IEEE WCNC, 2007, pp. 2473-2478.
[19] C.T. Hager, S.F. Midkiff, ‚An Analysis of Bluetooth Security Vulnerabilities', in Proc. IEEE WCNC, 2003, pp. 1825-1831.
[20] A. Sikora, V. Groza, ‚Coexistence of IEEE802.1.4 with other Systems in the 2.4 GHz ISM-Band', in Proc. IEEE IMTC, 2005, pp.1786-1791.

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