International Journal of Engineering & Technology, 7 (2.33) (2018) 422-425

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

A medication self-management system with real-time health monitoring

K. Lakshmi Joshitha [1] *, Aadhira Suresh [2], B.Bharathi [2], G. E. Dhivya [2]

[1] Faculty, Department of ECE, Sri Sai Ram Engineering College ,Chennai, India
[2] Final UG, Department of ECE, Sri Sai Ram Engineering College ,Chennai, India
**Corresponding author E-mail: lakshmi.ece@sairam.edu.in*

Abstract

India is the world's second largest country with lots of human resource. According to a survey of United Nations Department of Economic and Social Affairs, Population Division, with a tremendous medication and monitoring facilities in the health care, the rise in the elderly population will be from 7.5% in 2010 to 11.1% in 2025.However half of the elderly population are dependent and experience greater burden of ailments like the cardiovascular and circulatory illness, arthritis etc. With most of the youngsters working, the issue in taking care of the elderly people needs to be automated in all dimensions. The proposed work aims at designing a wearable device for health monitoring of elderly people who are not in a position to move swiftly. The device monitors the user's ECG and pulse rate. The device is compact and user friendly. Besides, the proposed system also includes an automated pill box which issues the right pill on command that is loaded al-ready in it.The sensed data is intimated through an android application to the concerned person. On reception, the data is analyzed and the person sends an appropriate code using a telegram application. This code activates the pill box to open up the right compartment and delivers the pill to the ailing elderly patient. Further monitoring can be done after the medication to ensure the patient's condition. The set up can as well be fitted in a wheel chair for the timely delivery of the pills to a person moving in it.

Keywords: *Health Monitoring; Wearable Device; User Friendly; Automated Pill Box; Android Application.*

1. Introduction

As there is a huge growth in the technology, it is important for the mankind to believe and understand the indispensable vital thing of life, which is health. With the level of growth in IoT, prioritizing the need of medication using assistive devices is important for us which contributes to a healthy and peaceful life. Adaptive, Assistive, and Rehabilitative devices, which are classified into software, hardware based using a node microcontroller unit connecting
it to the intelligent pill-box and to create an ease for the vulnerable and elderly groups, even for pregnant women in of emergency and no proper guidance. According to the health promotion administration (HPA), 88.71% of the aging people suffer from at least one chronic disease. To stabilize the condition, we require prolonged prudent medication and as elderly people are helpless at times in identifying the appropriate medicine among a number, it becomes our responsibility to do something which eases this complex task and provides relief. As the elderly people forget to take medicine regularly and are not used to this modern kind of technologies, we propose our work to make an efficient, regular and easy way of consuming medicine even when the person is alone. Internet of things (IoT) is a global network infrastructure linking physical and virtual objects through the exploitation of data capture and communications capabilities. With the help of such technology, we can reduce the problems of consuming inappropriate medicine to some extent and it offers a continuous monitoring of the patient therefore, helping and making things easier, faster, safer and smarter. Section II deals with the related works where Section III deals with the work flow and Section IV deals with the hardware setup and the component description. Section V gives the results and discussion with section VI concludes the paper with the future work.

2. Related works

In this section, a collaboration of electronics ,mobile computing and software is used to implement automatic pill dispensary. These works rendered us the options and solutions to propose our work on automatic pill dispensary during emergency situations. In reference [1] a system is set up to continuously monitor the medication schedule using arduino .This system is not suitable for emergency situations where SMS is send to the patient through a GSM network and also the entire pillbox is opened which might land the patient in confusion on what pill is to be consumed. In the design discussed in [2], a webduino module is being installed in SPB enabling in a two way messaging with remote relatives via IoT. Like the previous work, this remains unsuitable in emergency situations. A reminder is sent to the patient either by text or by voice through Wi-Fi using arduino. In [3] ,it is a medication system using WSN that involves usage of seven portable pill boxes, both combines and uses RF module, 16 bit microcontroller and zigbee for communication. Another solution has been discussed in [4] which present a work on scheduled medication using arduino and zigbee with no priority given during emergency situations. Here desktop systems are made use as back end system. There are a lot of solutions being offered for scheduled medication delivery more than the above mentioned designs. Till today, there has been no accurate solution offered for automatic pill dispensary during emergencies. Author of [5] tries to identify any gaps prevailing in the delivery and consumption of the prescribed drugs. A

Copyright © 2018 K. Lakshmi Joshitha et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

smartphone-based medication self-management system was developed in [6]. Work of [7] uses the Bluetooth connection to transmit the collected data and also manages to re-establish the connection automatically when failed. The work in [8, 9, 10] deals with the intelligent monitoring system with the wearable device for specific diseases. The proposed system in this work will offer a solution that sort out the issues at emergency situations using the field of IoT.

3. Work flow

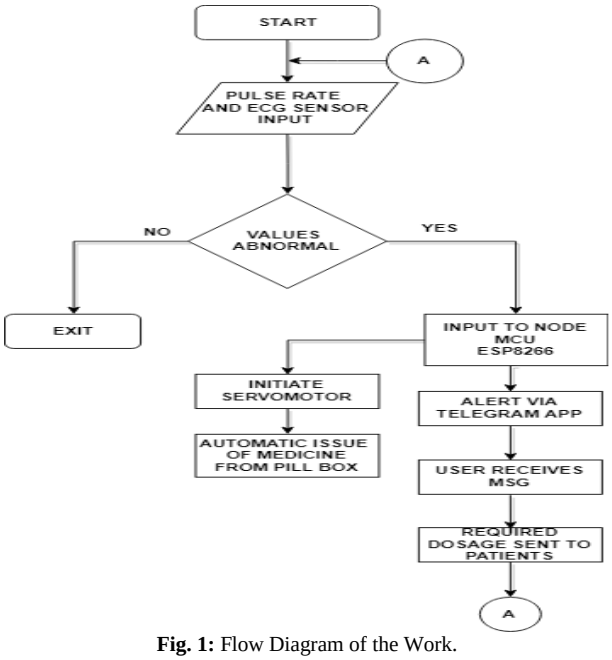


Fig. 1: Flow Diagram of the Work.

4. Hardware setup

We propose a work which helps the patients with the help of several sensors like ECG sensor, pulse rate sensor and in case of emergency with the emerging wireless technology. Fig 2 gives the hardware setup. The analysis from the sensor is transmitted using the ESP8266 Wi-Fi module. It can be made use like a patient monitoring process as well . The data is sent to the doctor, nurse and a keeper. The response is passed on through a messaging platform Telegram, since it is comparatively more secure than other messaging platforms.

The pill box also known as the the Intelligent Pill Box(IPB) is connected to the microcontroller and using arduino, it is programmed on which pills to be used at which point of time and it also depends on the situation. So each part of the box is encoded with certain codes and according to the codes, each box opens up and the patient can reliably consume the right pill and the prescribed amount of dosage without any need of in-person guidance. This creates a sense of safety and relief in certain grounds. The servo motor is used for opening and closing operations and is also small and compact. The LCD displays the condition and the medication required. The buzzer which is of 5V is programmed to indicate the appropriate time for medication.

The alternative methods rather than the old conventional methods looks promising and necessary .Due to that, only 1 in 10 people in need have the access to this technology today because of high cost and lack of awareness, availability, personal training, policy and financing. The introduction of IPB devices in loT leads us to a future where important information of patients would be available anytime and anywhere, in order to diagnose correctly and to prevent calamities. Setting up an appropriate reminder system combined with new type of dosages in a device may be a possible solution for temporary use but to interact in a better way with a keeper or doctor who is tired most of the time to keep track of their patients' problems, the proposed work is a requirement. Fig 1 shows the work flow and Fig 2 illustrates the block diagram.

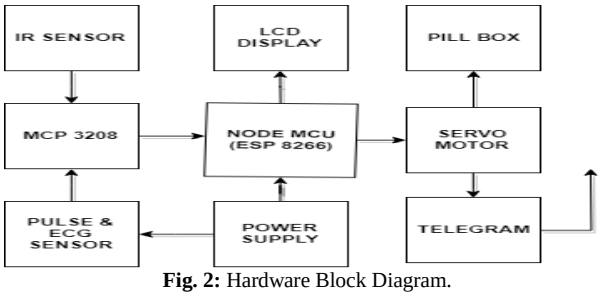


Fig. 2: Hardware Block Diagram.

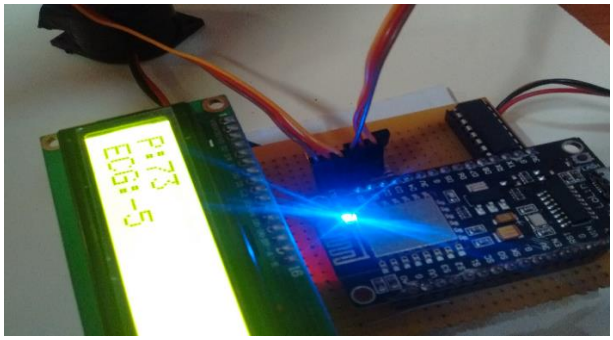


Fig. 3: Node MCU Interfaced with LCD and Sensors.

The microcontroller is programmed using arduino and the hardware response is achieved so. The response is generally from the doctor who is connected through the ESP 8266 module and the telegram application at the other end. The sensor values are analog values and hence we need a analog to digital converter so that it helps to transfer the data in a wireless manner to long distances.. The analysis from the sensor is based on the specified normal ranges and whether the level drops or rises from the threshold. The doctor receives the notification and responses on which dose to be taken at which level is based on the requirement of the patient and hence the process needs no guidance and even if the doctor is in a far off place, So, the risk is less. During pregnancy the proposed work will prove to be the best and safest system because the patient need not panic or suffer. The sensors pull the values and conveys, the response is stored and the box is opened. The patient can just consume the pill and hence, during any kind of situation necessary medication is provided.

4.1. Node MCU

The Node MCU is an open-source firmware and development kit that helps us to prototype our IOT product with the use of Lua script lines. Fig 3 shows the interfacing of Node MCU with the other components.

The Development Kit based on ESP8266 integrates GPIO, PWM, IIC, 1-Wire and ADC all in one board. It has USB-TTL,10 GPIO pins where every GPIO can be PWM, I2C, 1- wire .It is also an FCC certified Wi-Fi module with PCB antenna.

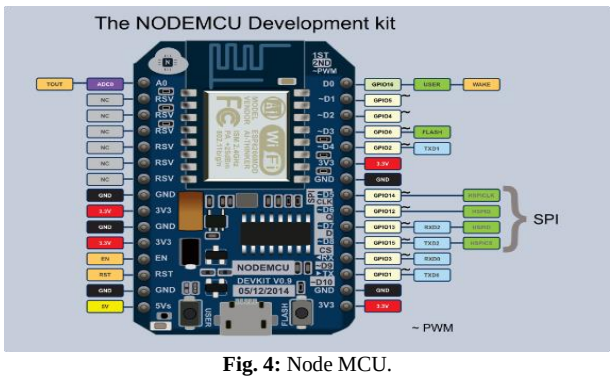


Fig. 4: Node MCU.

4.2. Pulse rate sensor



Fig. 5: Pulse Rate Sensor.

Pulse Sensor is a plug-and-play heart-rate sensor for Arduino. It can be used by the students, artists, athletes, game & mobile developers who want to easily incorporate live heart rate data. The range of the pulse is from 0 to 200 beats per minute and the pulse waveform has a 12-bit resolution ranging from 0 to 5V where it accounts for 1.25mV for one bpm. The pulses are sampled and achieves a maximum sampling rate of 100 samples/second with a time response of 10 seconds where the data logger input type is digital.

4.3. MCP 3208

MCP3208 is a 8 channel analog to digital converter that operates at a voltage range of 2.7V to 5.5V. It is a 12bit ADC with SPI serial interface. The MCP3208 is programmable to provide four pseudo differential input pairs or eight single ended inputs. The MCP3208 is offered in 16 pin PDIP and SOIC packages.

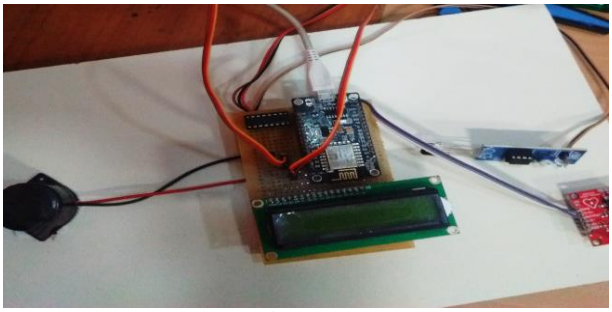


Fig. 6: Node MCU Interfaced with Buzzer and IR Sensor.

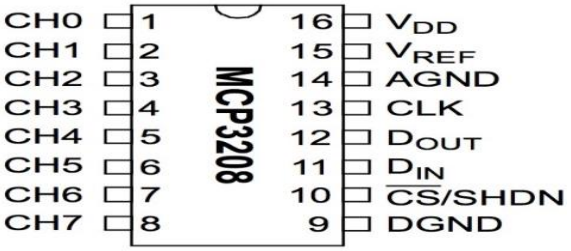


Fig. 7: 8- Channel ADC.

4.4. ESP8266

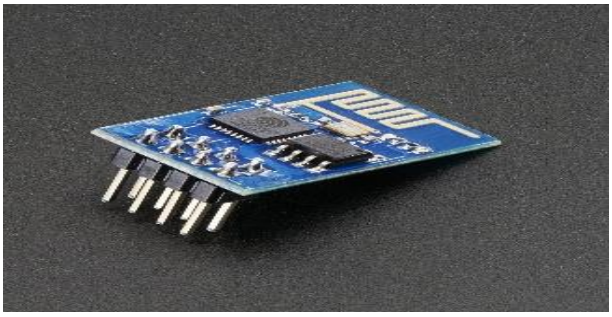


Fig. 8: Built in Wi-Fi.

The ESP8266 is a module that has built-in wifi which makes use of 802.11 b/g/n protocol. It is integrated with TR switch, balun, power amplifier, matching network and LNA. It also has an integrated PLL, power management units and regulators with temperature sensor. It supports antenna diversity and has a power down leakage current which is less than 10uA and had 0.4us guard interval. It also has an 19.5dBm output power 802.11b mode and wakes up and transmits packets in less than 2ms with a standby power consumption less than 1mW. module has an integrated low power 32-bit CPU which can be used as an application processor.

4.5. Servo Motor SG90



Fig. 9: Servo Motor.

Servo motor is tiny and light weight with high output power. It can rotate approximately 180 degrees (90 degrees in each direction). It has an operating voltage of 4.8v. The dimensions of servo motor are 22.2 x 11.8 x 31 mm approximately. The total weight is 9g.

4.6. ECG Sensor

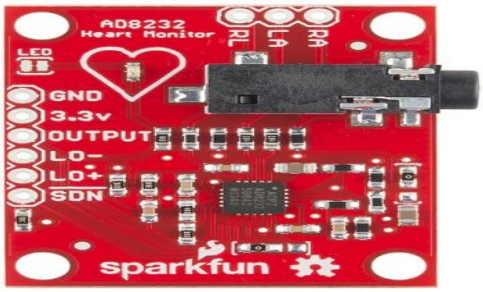


Fig. 10: ECG Sensor.

The sensor has 2 or 3 electrodes with a virtual reference operates at a range of 1.5mV with an input impedance of 100Gohm.It has a CMRR of 110db and operates at a bandwidth of 0.5-40 Hz with gain of 1100.The main features are its bipolar differential measurement with a pre-conditioned analog output. It has high Signal-to-noise ratio and is also easy to use. The buzzer used to alert is 8550 triode driver that can be controlled with single chip microcontroller IO directly and has an operating voltage of 5V.The dimensions of the board are 22(mm) x 12(mm). The set- up also has a LCD display that consists of a built-in controller with a 5V power supply and the board has 5 x 8 dots with cursor. The B/L is driven by pin 1, pin 2 or pin 15, pin 16 or A.K. Fig 4-10 shows the hardware components used in the proposed work.

Table 1: Measured Parameter and Analysis

Measured parameters		Condition		Results	
Pulse rate	ECG			Pill box 1	Pill box 2
Trial 1					
75	-7,43,69	N	N	closed	Closed
90	-38,5,58	A	A	Opens	Opens
86	-31,23,51	N	A	Closed	Opens
93	0,32,79	A	N	Opens	Closed
Trial 2					
78	-10,48,62	N	N	Closed	Closed
55	-15,59,87	A	N	Opens	Closed
69	-45,28,93	N	A	closed	Opens
83	4,31,89	N	N	closed	Closed
Trial 3					

62	-39,52,96	N	A	closed	Open
72	3,54,77	N	N	closed	closed
91	-13,29,63	A	N	opens	closed
95	0,48,107	A	A	opens	opens

N-Normal, A-Abnormal

4.7. Telegram

Telegram is another messaging platform like what's app but it is not more secure. The key features and importance of using telegram are the key Mist information is spread out rapidly to the palm of our hand and has wider potential catchment position. It is possible to access telegram from multiple devices simultaneously and also the history is maintained and hence new members can view the previously sent resources. There are also certain drawbacks like saturating and resulting in important messages being missed because of constant messaging and the messages will be received.

5. Results and discussions

The normal value of the pulse rate is 70-100 for children and 60-100 for the adult. On an average setting the threshold as 90 beats/min the testing is done. We find that the false alarm is almost nil in about 10 trials taken out of which four are tabulated. The normal values of ECG deviations being -30 deg to +105 deg. The values beyond +105 to +180 deg are the right axial variation called right ventricular hypertrophy. Any variations beyond -30deg (i. e) -90 deg to -30 deg is left axial deviation called left ventricular hypertrophy. Fig 11 shows the telegram app used to message the measured parameter tabulated in table 1.

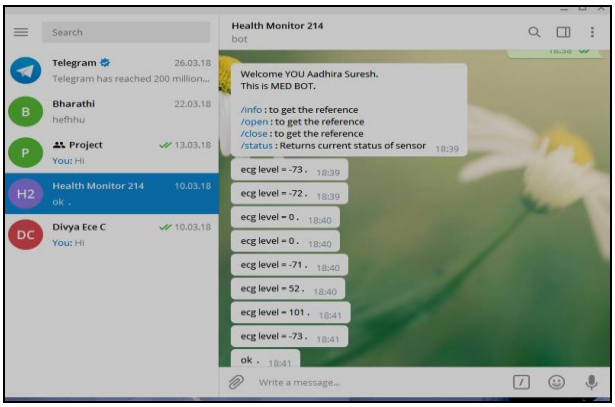


Fig. 11: Messaging Tab of Telegram with Monitored Parameters.

6. Conclusion

The proposed system can be made use by pregnant ladies and elderly vulnerable groups. The main application of the proposed work is scheduling and giving appropriate dosages at the right time. The system proves to be a lifesaving act by making efficient use of wireless technology and reduces the complexity when the person is alone. The proposed work serves as an effective solution to the medical non-compliance problem and gives quality treatment. The system can be enhanced further to alert the neighbors during emergencies and by scheduling to take medicines at regular intervals as well as during emergency situations and other parameters like seizure sensing can be done.

References

[1] Parra, J. M., Valdez, W., Guevara, A., Cedillo, P., & Ortiz-Segarra, J. (2017, February). Intelligent pillbox: Automatic and programmable Assistive Technology device. In *Biomedical Engineering (BioMed), 2017 13th IASTED International Conference on* (pp. 74-81). IEEE.

[2] Tsai, H. L., Tseng, C. H., Wang, L. C., & Juang, F. S. (2017, June). Bidirectional smart pill box monitored through internet and receiving reminding message from remote relatives. In *Consumer Electronics-Taiwan (ICCE-TW), 2017 IEEE International Conference on* (pp. 393-394). IEEE.

[3] Chang, W. W., Sung, T. J., Huang, H. W., Hsu, W. C., Kuo, C. W., Chang, J. J., & Yang, Y. J. (2011). A smart medication system using wireless sensor network technologies. *Sensors and Actuators A: Physical*, *172*(1), 315-32.

[4] Huang, S. C., Chang, H. Y., Jhu, Y. C., & Chen, G. Y. (2014, May). The intelligent pill box-Design and implementation In *Consumer Electronics-Taiwan (ICCE-TW), 2014 IEEE International Conference on* (pp. 235-236). IEEE.

[5] Garçon, L., Khasnabis, C., Walker, L., Nakatani, Y., Lapitan, J., Borg, J., & Velazquez Berumen, A. (2016). Medical and assistive health technology: meeting the needs of aging populations. *The Gerontologist*, *56*(Suppl_2), S293-S30.

[6] Hayakawa, M., Uchimura, Y., Omae, K., Waki, K., Fujita, H., & Ohe, K. (2013). A smartphone-based medication self-management system with real-time medication monitoring. *Applied clinical informatics*, *4*(01), 37-52.

[7] Hayes, T. L., Hunt, J. M., Adami, A., & Kaye, J. A. (2006, August). An electronic pillbox for continuous monitoring of medication adherence. In Engineering in Medicine and Biology Society, 2006. EMBS'06. 28th Annual International Conference of the IEEE (pp. 6400-6403). IEEE.

[8] Alarm Pill Box, Raven, M. R. (1991). *U.S. Patent No. 5,020,037*. Washington, DC: U.S. Patent and Trademark Office.

[9] Eswaran, U., Eswaran, V., & Sudharshan, V. B. (2013, April). Human like biosensor disease simulator, disease analyzer and drug delivery system. In *Information & Communication Technologies (ICT), 2013 IEEE Conference on* (pp. 1033-1038). IEEE.

[10] Andreoni, G., Perego, P., & Standoli, C. Wearable monitoring of elderly in an ecologic setting: The SMARTA project. In *Available online: https://sciforum.net/conference/ecsa-2/paper/3192/download/pdf (accessed on 5 January 2017)*.