Let Us Manage BP Monitor Data Using WordPress Server and C#

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ABSTRACT

Purpose: *Nowadays, due to our unhealthy lifestyle, hypertension is a common and serious issue. We visit the doctor for a regular checkup at specific intervals. The doctor asks for a record of BP to review the medicine. Generally, we write our BP records on paper and carry them to show the doctor. There are a couple of disadvantages in this procedure. At first, most of the time, we did not find our paper at the time of the doctor's visit. Sometimes, the doctor is not able to read the handwriting. The doctor needs more time to estimate the high, low, and average BP record till the last visit. Sometimes, doctors prefer the BP curve. However, this procedure is more challenging. If any one of the events does not happen as expected, the treatment might go wrong. We need a good solution for the above all. We have the strength of various matured technologies. Applying those, we can solve the above situation quickly.*
Design/Methodology/Approach: *Now, the solution is to record our BP data electronically rather than handwritten so that doctors can understand it easily. To store the bp data, we use a database. We will use a cloud database so that it can be accessible from anywhere. We can use a PC or mobile application to enter the BP data. We must enter the current reading whenever we measure BP using the apps. That is it. The application does the rest of the process.*
Findings/Result: *As we describe, the procedure is primarily hectic. To enter bp data by opening is a time-consuming task. However, once familiar to us, it has excellent benefits. Once they adopt it, it will become a user-friendly tool to manage the BP data.*
Originality/Value: *Several procedures are available to store and display the BP record. The smartwatch is a generic device that stores the data inside the application and then displays it according to our needs. However, it has serious drawbacks; in some ranges (as observed in the high range), it does not provide an accurate value. Here, we are capturing the bp data from a dedicated bp instrument, which we can consider a reliable data source. Our application aims to provide as accurate data as possible to the doctors who need information. So, the application provides actual value to the user.*
Paper Type: *Conceptual Research.*
Keywords: bp data management, CRUD operation on WordPress server, MQTT protocol demonstration using C#. Intelligent bp data management system, how to communicate between WordPress and C#.

1. INTRODUCTION :

Problem statement: Hypertension patients are rising high around the globe. We have lots of severe diseases like heart attack or stroke, heart failure, kidney problems, eye problems, etc. we suffered. Most of the scenarios are life-threatening diseases. The problem is that, in most cases, hypertension does not show symptoms. It is asymptomatic. It is a silent killer. Its leading cause is our lifestyle. It can be detected when we measure using a BP monitor. When we visit the doctor, the doctor measures the BP and prescribes the medicine based on a single measurement. The doctor always prefers the series of data, which means the bp data with different time intervals. The problem is that, in most cases, there is

no BP monitor machine. Sometimes, the BP monitor is present but does not record correctly. We observed some instances where the BP monitor record was available but not in a proper time manner; at the time of the doctor visit, they did not find or forgot to carry the record. Like other diseases, it is serious. The proper diagnosis is mandatory, or else it can be life-threatening. So, to get a practical solution, we need to automate the complete process so there is no chance of mismanagement.

Indication of methodology: We feel most problems are solved using the automated process. Users need to enter data inside the application. Our application does the rest of the process. We create an application using C# dot net with a graphical user interface (GUI). The same application can be developed in mobile applications for more acceptability. When the user opens the application, a blank textbox field is depicted in Figure 2. After the bp measurement, input the value to the corresponding field and press the submit button. No more work needs to be done by the user.

Essential findings of others in this field: The health system is becoming automated. Soon, the complete health infrastructure will be fully automated. There is much research going on on cloud-based health management systems. Yang et al. (2021) [1] designed and developed a long-term care management system based on IoT. Melillo et al. (2014) [10] developed a cloud-based automated remote processing system for hypertensive patients. In the following year, they publish another work (Melillo et al. (2015) [2]) on automated cardiovascular and risk management systems for the same type of patient. Kwon et al. (2016) [29] worked on IoT-based health management systems for industrial applications. One IoT-based system for humanity works (Swamy et al. (2019) [30]) on an intelligent health management system.

What is done in this paper: We study how we can provide the bp management system for the general users' daily lives and accurately automate the system to manage the patient's bp data. The patient can get improvement information on its own. A self-healing process can be initiated using the system. Using the graph, we can get a visible idea of the health improvement.

Principal conclusion: Health is an essential factor, especially about blood pressure. Several research has been carried out. Most of the technology is good but so complicated. Here, we provide a straightforward way to manage the BP record. Data is essential, and that is why we take care of it. We save the user input data to the cloud server so that we can access it anywhere. Using our GUI application, users can get the most wanted data and display it in various understandable formats. Without purchasing costly software, we provide the procedure for doing that.

2. REVIEW OF LITERATURE/ CURRENT STATUS :

We study several research works on the latest trends in medical technology, cloud computing, and several medical solutions based on IoT technology. In the table below, we summarized a couple of good research and what components they used in their research work.

Table 1: List of various research and technology used in the area of IoT based Health Care

S. No.	Focus/Subject	Technology/Algorithm/ Module/Components	Reference
1	Design and Development of a Long-term Care Management System Based on the Internet of Things. Sensors & Materials	IoT, HTTP, MQTT, WeMos D1 demo board	Yang et al. (2021). [1]
2	Cloud-based intelligent health monitoring system for automatic cardiovascular and fall risk assessment in hypertensive patients.	Cloud computing	Melillo et al. (2015). [2]
3	Checking GDPR Compliance of WordPress Plugins via Cross-language	WordPress, WordPress plugin	Shezan et al. (2023). [3]
4	CRUD Operation on WordPress Database Using C# SQL Client	WordPress, C#, SQL Client	Chakraborty et al. (2023). [4]
5	CRUD Operation on WordPress Database Using C# And REST API	WordPress, C#, REST API	Chakraborty et al. (2023). [5]

6	CRUD Operation on WordPress Posts from C# over REST API	WordPress, C#, REST API, WordPress Posts	Chakraborty et al. (2023). [6]
7	Database-access performance antipatterns in database-backed web applications	Database, SQL interfaces	Shao et al. (2020). [7]
8	Adequate Data Privacy and Security for a Cloud Using Three-Layer Fog Computing	Secure Data Storage, Encryption Algorithm	Bharathi et al. (2022). [8]
9	Smart Water Meter	Arduino Uno, ESP8266 Wi-Fi Module, DS3231, USB TTL converter	Sani et al. (2020). [9]
10	Cloud-based remote processing and data-mining platform for automatic risk assessment in hypertensive patients. In Ambient Assisted Living and Daily Activities	Remote processing, data mining	Melillo et al. (2014). [10]
11	Cloud data management	RDBMS, NoSQL	Zhao et al. (2014). [11]
12	Secrets of developing high-performance web applications using C# and ASP. NET	C#, ASP. NET Core 2	Singleton et al. (2017).[12]
13	An IoT-based predictive connected car maintenance approach	Internet of Things (IoT)	Solanki et al. (2017). [13]
14	A Practical Approach To GIT Using Bitbuc ket, GitHub, and SourceTree	Bitbucket GitHub, SourceTree	Chakraborty et al. (2022). [14]
15	Industrial Automation Debug Message Display Over Modbus RTU Using C#	Modbus RTU, C#	Chakraborty et al. (2022). [15]
16	Modbus Data Provider for Automation Researcher Using C#	C#, Modbus	Chakraborty et al. (2023). [16]
17	MVVM Demonstration Using C# WPF	C#, WPF	Chakraborty et al. (2023). [17]
18	How to make IoT in C# using Sinric Pro	C#, Sinric Pro	Chakraborty et al. (2022). [18]
19	Virtual IoT Device in C# WPF Using Sinric Pro	C#, WPF, Sinric Pro	Chakraborty et al. (2022). [19]
20	Create An IoT Inside the AWS Cloud	AWS IoT	Chakraborty et al. (2023). [20]
21	Let Us Create a Physical IoT Device Using AWS and ESP Module	AWS, ESP Module	Chakraborty et al. (2023). [21]
22	Let Us Create Multiple IoT Device Controller Using AWS, ESP32 And C#	AWS, ESP32 And C#	Chakraborty et al. (2023). [22]
23	Let Us Create Our Desktop IoT Soft-Switchboard Using AWS, ESP32 and C#	AWS, ESP32, and C#.	Chakraborty et al. (2023). [23]

24	Let Us Create A Lambda Function for Our IoT Device In The AWS Cloud Using C#	C#, AWS IoT, Lambda function	Chakraborty et al. (2023). [24]
25	IoT-Based Industrial Debug Message Display Using AWS, ESP8266, And C#	AWS IoT, ESP8266, C#	Chakraborty et al. (2023). [25]
26	IoT-Based Switch Board for Kids Using ESP Module And AWS	ESP Module and AWS IoT	Chakraborty et al. (2023). [26]
27	An approach towards IoT-based healthcare management system	IoT	Singla et al. (2021). [27]
28	An IoT-based patient health monitoring system	IoT	Krishnan et al. (2018). [28]
29	IoT-based prognostics and systems health management for industrial applications	IoT	Kwon et al. (2016). [29]
30	an IoT-based intelligent health monitoring and management system for humanity	IoT	Swamy et al. (2019). [30]

3. OBJECTIVES OF THE PAPER :

The research aims to provide a systematic procedure for managing our BP data. Several procedures are available in the field. However, when it comes to reliability and consistency, most of the procedures are not compliant. So, we try to find a procedure to manage our BP data nicely and provide consistency. The paper is conceptual and follows a research model of Conceptual-based research work where we meet several objects, which are as follows:

(1) To study the feasibility of BP data management using remote databases and PC applications.
(2) To test the system functionality that we proposed.
(3) To compare the effectiveness of the research project with the existing available system.
(4) To evaluate the system performance over the cloud.
(5) To develop a robust system that will be treated as an essential component in everyday life.
(6) To interpret how to manage our BP data through the application
(7) To create a helpful system in daily life, especially for hypertension patients.
(8) To identify the bottleneck to implement this kind of system.
(9) To determine whether to continue this research work for everyday use.

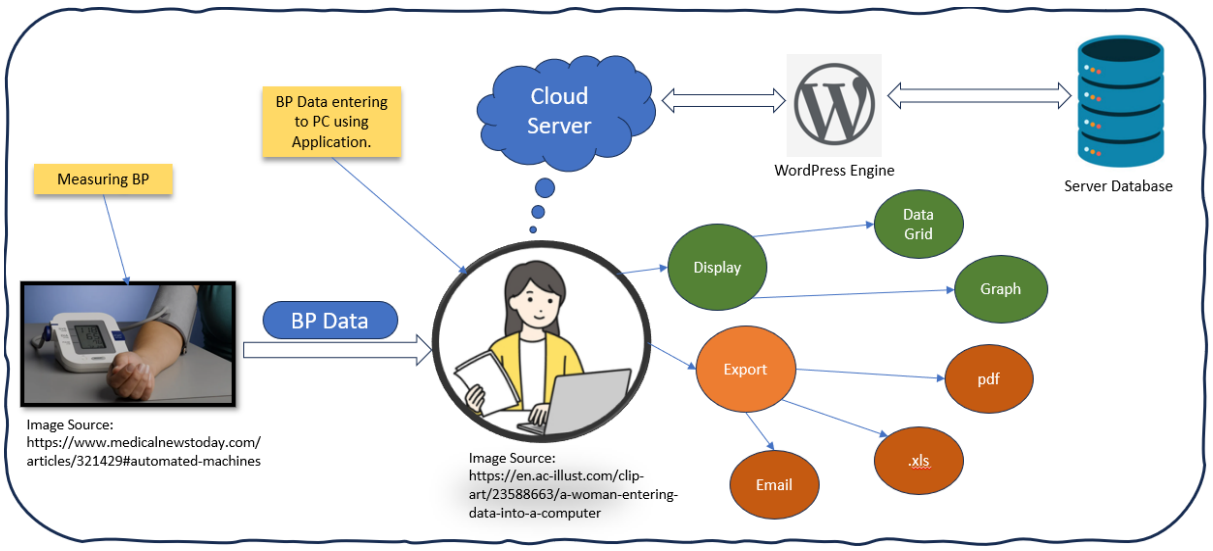

Fig. 1: The project block diagram

4. METHODOLOGY :

Figure 1 depicts the project block diagram. The process workflow initiates the reading of the BP by the patient after reading the systolic. Diastolic and pulse value using a bp monitor. Then, the user inputs the value using the application. It will be saved to the cloud database. When we press the submit button, the PC or working system tries to connect with the WordPress engine over the MQTT protocol. Once the server is found, it starts transmitting the data. WordPress saves the data to the server database. In the application, we added some facilities we usually need. These are two displays: one is to be displayed in Datagrid or tabular form, and the other is a graph. There are also a couple of options to export the result. We can export it in PDF, .xls, or .csv format or send over the email ID. We can send the result directly to the doctor's email ID using the application.

We can build an application like Figure 2. The interface has been developed using C# language. The interface project link is available in the recommended section. To create the complete the project according to the project block diagram, which is depicted in Figure 1, we need to follow the below steps:

1) Inside the GitHub, create a repository. Create a folder on the desktop. Clone the repository. The paper[14] might be a guide to creating a repository.
2) Download and install the Visual Studio Community edition from https://visualstudio.microsoft.com/downloads/. Configure IDE for c# language.
3) Create a C# desktop application inside the clone folder.
4) We need to install WordPress locally. It is safe and hassle-free. To install wordpress, the paper[4][5][6] is a good reference.
5) Create C# application
6) Test the application. If an issue is found, debug it carefully.

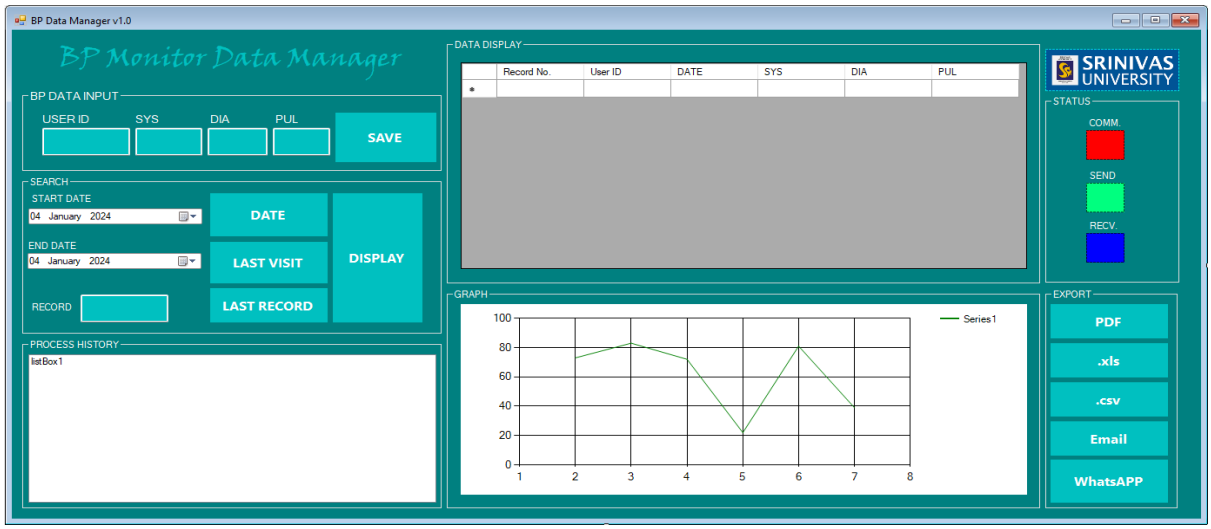

Fig. 2: The proposed application interface.

5. RESULTS & DISCUSSIONS :

The general stream is not to take care of our past health data. However, seeing our past data, we get the treatment trend. Going cured or need to fine-tuning. The available software in the market is so costly that we cannot afford it. So here we provide with little cost, we can build a small application to manage our bp data.

6. ANALYSIS / Comparison OF RESULTS :

According to the architecture, overall system performance is pretty good compared to other methods. The system should be as fast enough as possible. The described system can run in two ways. The main backbone of the application is the server where we store the data. If we use a local system, we can use a local database. It provides us with maximum speed as compared to remote databases. However, in some scenarios, we need to store the database in the remote database. You need to select a server that

provides high bandwidth. Otherwise, the user experience might go wrong. The working system should also be as latest as possible for better performance. If the complete infrastructure is perfectly tuned, it must provide maximum throughput.

7. SUGGESTIONS / RECOMMENDATIONS :

- The interface project designed in Figure 2 is available from https://github.com/sudipchakraborty/Let-Us-Manage-BP-Monitor-Data.git
- The application can be developed using a C#. The researcher can also develop Android or iOS-based applications. Nowadays, It is more acceptable than PC applications.
- The application is medical, so we need extra care for robustness and reliability.
- Several report formats might be needed for custom requirements. The researcher needs to cover most of the format.

8. CONCLUSION :

BP data management is essential for various reasons. To send the data to the doctor or to see the treatment improvement in ourselves, we need to observe the data to progress the curve. Several procedures are available to manage the health data. Here, we observe a simple yet powerful method to manage our BP data nicely. From our application, we export in various formats so that it is widely acceptable. From this application, we send the report to the doctor's email ID so the doctor can get the digital report immediately. Through this research, those trying to integrate and manage the BP data nicely can get some valuable information.

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10. LIMITATIONS :

We observed a couple of drawbacks, which are listed below:-

- The main backbone of the system is manual entry. The complete calculated result goes wrong if the user enters an error or wrong data. That incident might also hurt the treatment.
- It is a time-consuming process.
- The application performance depends on the working system and internet speed. The data will be saved to the remote database and accessed from anywhere. The data flow or speed needs to be as fast as possible to get a faster application response. If we use a local server, the server data might not be accessible over the internet.
- There is a recurring cost for the online server database.

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