Cloud Based Maternal Women Health Monitoring System

Sandesh.S.Puranik [1*]
Mangalore Institute of Technology & Engineering, Department of Mechatronics Engineering.

Anup.S.Gouraj [1]
Mangalore Institute of Technology & Engineering, Department of Mechatronics Engineering.

Sandesh.Shetty [2]
Mangalore Institute of Technology & Engineering, Department of Mechatronics Engineering.

Arun.U. Naik[2]
Mangalore Institute of Technology & Engineering, Department of Mechatronics Engineering.

Shravana Karantha P [3]
Mangalore Institute of Technology & Engineering, Department of Mechatronics Engineering.

***Abstract*— Pregnancy is a unique moment in a woman's life when she becomes aware of her lifestyle choices and how they effect the foetus.Good quality maternity care is necessary to detect problems in the early days and stabilize the health condition of both mother and unborn baby health and well-being.Many researches have proposed maternal health observing systems so far.They are, however, either specialized to a specified health concern or conserved to questionnaires and short term data gathering methods. Furthermore, long-term research has not been conducted to examine the requirements and obstacles. Maternal health demands a robust structure that allows pregnant women to be monitored continuously. We offer a controller-based system for maternal health monitoring throughout pregnancy and the postpartum period in this work. The system is made up of a number of data collectors that follow the mother's health.**

Keywords—Maternal Health Monitoring, Continues monitoring, Maternity care, Fetus's health, acute pregnancy problem, prenatal checkups

I. INTRODUCTION

Maternity care focuses to safeguard both expectant mothers and her fetus's health and well-being. Maternal health care has a significant impact on the unborn both during maternal period and in the upcoming days. Furthermore, issues during maternal period, such as hyperglycemia or hyperparathyroidism, can be associated to health issues in later life for pregnant woman. As a result, maternity concern is crucial for boosting long-term population health and also for reducing intense pregnancy complications in women. Prenatal visits should be scheduled on regular bases which are required to detect defects and avert future problems, injuries, or even death are all possible outcomes. Bp, blood sugar content, and, as well as uterine growth and maternal weight gain, have historically considered the most important quantify markers to monitor during pregnancy. In order to maintain a healthy life, pregnancy care experts must even advice on all-round lifestyle and self-concerns, such as physical exercise and rest. They are, still not presently being observed in a systematic way. As a result of technical advances in information and communication technologies, the way healthcare is delivered keeps changing. This is a novel paradigm that integrates numerous sensing, communication, and computing networks to create a complex club of things that can be accessed at any time and from any location.

II. PREECLAMPSIA

Preeclampsia, even known as toxaemia, is disorder which causes high pulse rate, and even swelling in the leg, feet, and hands in pregnant women. Its frequency might range from mild to severe. It usually happens late in the pregnancy, although it can happen earlier or immediately after birth. Preeclampsia can escalate to eclampsia, a dangerous illness that can put both mother and baby at risk and, in rare situations, result in death. If your preeclampsia causes seizures, get medical assistance right once. Preeclampsia symptoms can last for up to six weeks after birth. You may help protect yourself by being familiar with the symptoms of preeclampsia and constantly monitoring yourself if you become sick. Maintaining the Specifications' Integrity. Preeclampsia can also occur after a baby is born, which is known as postpartum preeclampsia. Among the many glucose measurement techniques, optical and electrochemical investigations have been thoroughly researched. Optical techniques rely on a change in colour in an indicator that signals glucose concentration.

III. LITERATURE REVIEW

Analytical analysis of intrauterine fetal neonatal mortality and related maternity conditions," Sharma S. **et al. [1**]. According to the source, there is a huge amount of literature introducing remote observing services in maternal period. The major part of these studies is being used question to keep the mother's health or even look at particular issues or health concerns that may emerge while in pregnancy period, such as hyper-tension, pre-term delivery, diabetes mellitus, and sleep abnormalities. Few studies have taken use of excellent IoT-based monitoring systems throughout pregnancy and after childbirth.

[2] Lopez, B., and others. The researchers propose a "wearable tech model to control and even monitor hypertension during pregnancy" in their paper, "Wearable technology model to control and monitor hypertension while in pregnancy." They investigated even in association between sleep problems and health-rated lifestyle of life using different questionnaires and wrist actigraphy (a non-invasive method for assessing sleep and activity) for seven days throughout each trimester. Other studies look at blood pressure, weight, and blood glucose levels in pregnant women to track hypertension and diabetes. Mothers with pregnancy hypertension were recruited to take part in a trial that included home blood pressure monitoring. If the number of women exceeded a specific threshold, they would be referred to hospitals.

L. Atzori **et al**. **[3]**. This paper is about the Internet of Things. This promising paradigm is primarily enabled by the integration of numerous technologies and communication networks. The most essential technologies are identification and tracking, wired and wireless sensor and actuator networks, better communication protocols (shared with Next Generation Technology), and distributed intelligence for smart objects.

S. Polsky **et al**. **[4].** Wearable devices have also been utilized to collect maternal health indicators on a continuous basis. An approach for monitoring hypertension during pregnancy is provided in. In this study, a commercial wristband was used to measure heart rate, step count, and sleep. The proposed method was tested at a healthcare facility for three months. This device was popular among pregnant women since it allowed them to keep track of their personal health in a non-invasive manner. The scientists described an Internet-of-Things-based monitoring system for assessing objective sleep quality. They used a smart wristband to continuously collect sleep data from parents and show a personalized model predicting sleep quality reduction depending on each person's data. Kumar and his colleagues provided health architecture for pregnant women, taking into account the need for system adaptation based on gathered health data

Krapf et al. **[5]** devised smartphone software that collects blood pressure and weight data from mothers and warns them if an issue is discovered Allahem et al. developed a method for tracking pregnant women who are at high risk of giving birth prematurely. They hoped to avoid preterm births by employing a body sensor to monitor uterine contractions and informing women via a mobile app if the data exceeded predetermined tailored thresholds. The researchers used a smartphone-based system with a Naive Bayes Classifier to make real-time choices..

A. Anzanpour and colleagues **[6]**. Wearable electronics-based remote health monitoring devices with self-awareness. In the Proceedings of the European Conference on Design, Automation, and Manufacturing, This study takes use of maternal health monitoring tools. However, they are restricted to a few health issues and are finished in a short period of time or with limited data collection methods. It is required to design a controller-based maternal health monitoring system that enables for continuous and long-term monitoring of a mother's health. Such monitoring should provide a comprehensive picture of a mother's health, supporting good practices throughout pregnancy and minimizing health risk factors.

METHODOLOGY

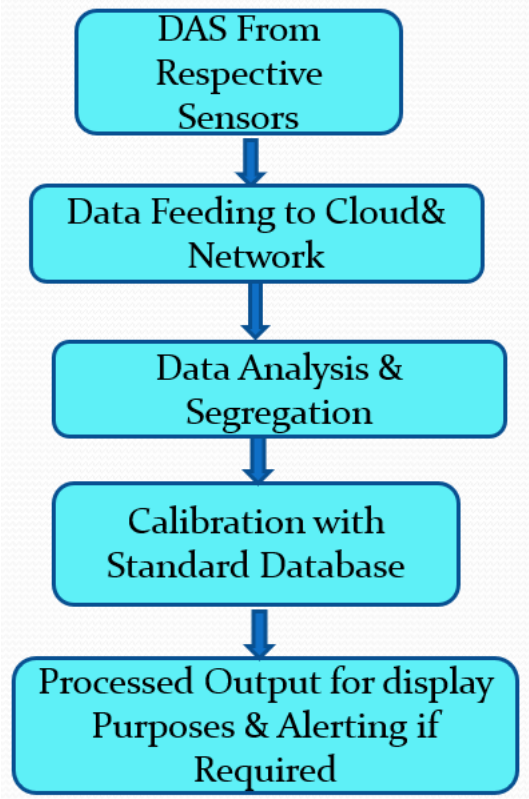


Fig 1 – Flowchart of Working Mechanism

A. Collection of data on various factors such as blood pressure, glucose level, SpO_2, temperature, and heartbeats from the corresponding sensors.
B. Analysing the collected data in relation to the Calibration method and providing a relevant result.
C. Calibrating the processed data against current standard data those medical practitioners commonly refer to.
D. Displaying the output in a simplified form that is easily understandable.

IV. CLOUD COMPUTING

Cloud computing refers to the on-demand, pay-as-you-go provision of IT services over the Internet. Rather than acquiring, running, and maintaining physical data centerss and servers, you may utilize a cloud provider such as Amazon Web Services (AWS) to receive as-needed technical services such as processing power, storage, and databases.

A. MECHANISM FOR DATA FEEDING AND RETREIVAL TO AND FROM THE CLOUD

There are four phases in the data lifecycle: -

• **Ingest**: The first stage involves bringing in raw data, such as streaming data from devices, on-premises batch data, app logs, or mobile-app user events and analytics.

• **Store**: Once the data has been obtained, it must be stored in a long-lasting and easily accessible manner.

• **Process and analyze:** The data is turned from its raw form into usable information at this level.

•**Explore and visualize**: The final stage is to turn the analysis' findings into a format that can be easily interpreted and shared.

B. SaaS Architecture

SaaS applications and services are frequently multi-tenant, which means that a single instance of the SaaS application will be running on the host servers, and that single instance will serve each subscribing client or cloud tenant. All clients or renters will utilize the same version and settings of the software. Despite the fact that many paying clients will run on the same cloud instance with a common architecture and platform, data from different customers will be kept separate. Because of the common multi-tenant design of SaaS applications, the cloud provider can manage maintenance, upgrades, and problem solutions more quickly, conveniently, and efficiently. Engineers can make critical changes for all clients by maintaining a single, shared instance rather than having to implement changes in several instances.

C. WORKING PRINCIPLE

All the user needs to do is wrap the BP kit around their left hand and insert their three fingers in the three slots specified, and that's all. The data will be captured and processed in the Nod MCU first before being fed to the cloud and reverted to the application where the calibration algorithm is used. It will compare the measured data with standard pre-fed data and provide an output where if one of five parameters or N out of five are exceeding or dropping below specified par, it will notify the user to seek medical assistance, preventing mishaps from occurring because these parametric rises cannot be felt in the early stages.

The application was created in AWS Honey code, with concerns such as simple UI, user-friendly hints, etc. in mind. The new user must first register on the sign-up page, where she must choose her credentials, before being sent to the layout, where she will see all five parameter tabs with indications and measured values. Because hypertensions and other danger factors are also a risk factor, we can forecast and present stress levels using blood pressure data.

D. STANDARD DATABASE

Table 1: - Standard Parameters

VITAL PARAMETER	Nonpregnant Adult	First Trimester	Second Trimester	Third Trimester
Systolic Blood Pressure (mmHg)	90 to 120	94.8 to 123.5	95.8 to 127.21	101.3 to 129.43
Diastolic Blood Pressure (mmHg)	60 to 80	55.5 to 86.9	56.8 to 87.1	62.4 to 94.7
Heart Beats (BPM)	60 to 100	63.1 to 105.2	67.4 to 109	69.5 to 112
Glucose Level (mg/dl)	95-110	97-118	101-124	110.5-130
Temperature in C°	36.5 to 37.3	35.55 to 37.51	35.55 to 37.35	35.37 to 37.37
Temperature in F°	97.8 to 99.1	95.99 to 99.52	95.63 to 99.27	95.67 to 99.23
SpO_2 Level in %	95 to 100	94.3 to 99.4	96 to 100	95.67 to 100

E. RESULTS OBTAINED

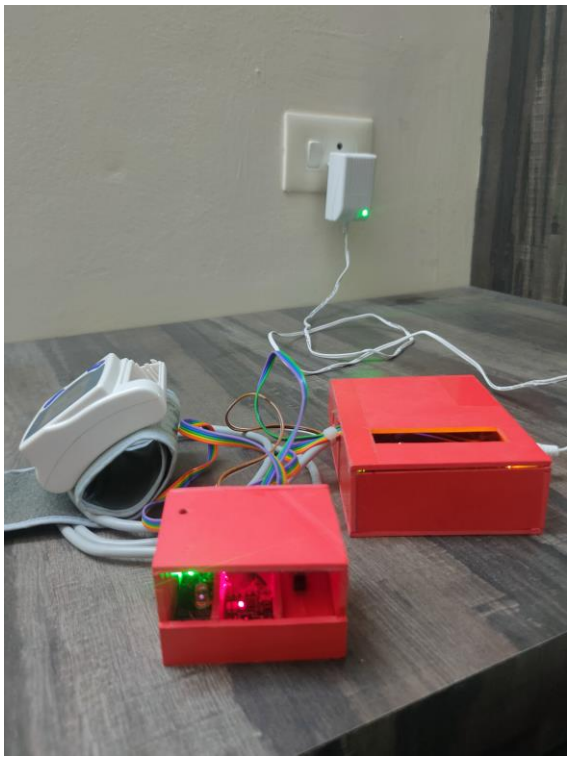


Fig 2 – Final device with sensor's integrated

Fig 3: - User worn the Device

Fig 4: - Application Interface (Green Indicates normal)

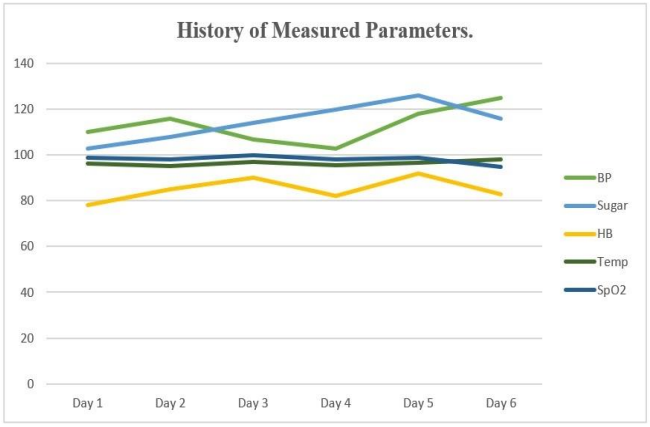
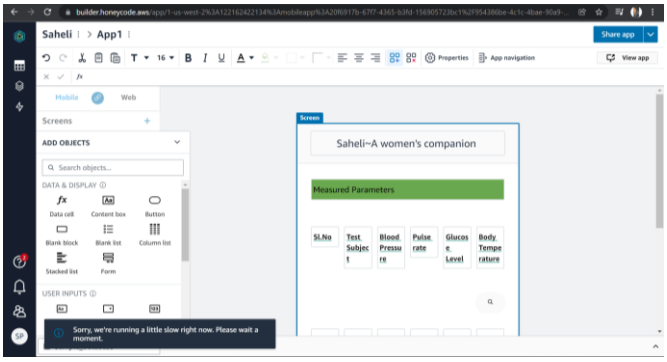
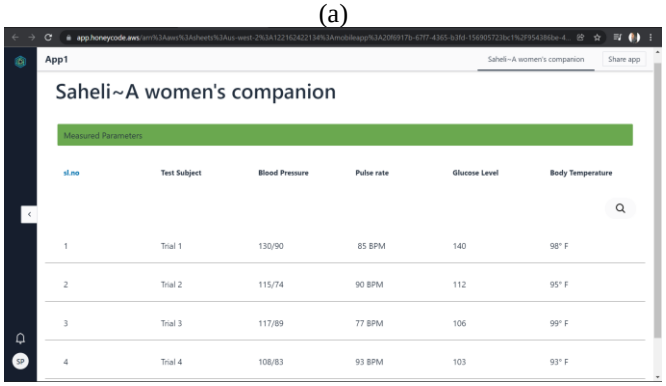


Fig 5: - The records of previously measured can be viewed to check for any improvement.



(a)



(b)

Fig 6 .: - AWS Cloud layout of recorded data

CONCLUSION

To summarize, Maternal health monitoring is essential to protect the mother's and child's health and well-being, since numerous health issues develop during pregnancy that have a long-term impact on their health. If such catastrophes are not averted by the use of the following described sensors guarding the corresponding parameters, the number of fatalities will rise and may become a larger problem. Premature births, preeclampsia, and a few other maternal associated diseases can be handled utilizing the suggested technology. We intend to do risk prediction and detection of numerous health concerns throughout pregnancy and postpartum in the future. Furthermore, we must evaluate this system for individualized action in order to reduce or eliminate harmful maternal health complications.

VIDEO LINK OF DEMONSTRATION OF WORKING MODEL

https://drive.google.com/file/d/1wfQ_Pek_7o-VIzm6waMNfB9M4h05OvV_/view?usp=drivesdk

REFERENCES

[1] Sharma, S.; Sidhu, H.; Kaur, S. Analytical study of intrauterine fetal death cases and associated maternal conditions.2016, 6, 11.
[2] Lopez, B.D.B.; Aguirre, J.A.A.; Coronado, D.A.R.; Gonzalez, P.A. Wearable technology model to control and monitor hypertension during pregnancy. In Proceedings of the 2018 13th Iberian Conference on Information Systems and Technologies (CISTI), Caceres, Spain, 13–16 June 2018; pp. 1–6
[3] Moreira, M.W.; Rodrigues, J.J.; Oliveira, A.M.; Saleem, K. Smart mobile system for pregnancy care using body sensors. In Proceedings of the 2016 International Conference on Selected Topics in Mobile & Wireless Networking (MoWNeT), Cairo, Egypt, 11–13 April 2016; pp. 1–4.
[4] Polsky, S.; Garcetti, R. CGM, pregnancy, and remote monitoring. Diabetes Technol. Ther. 2017, 19, S49–S59.
[5] Anzanpour, A.; Amiri, D.; Azimi, I.; Levorato, M.; Dutt, N.; Liljeberg, P.; Rahmani, A.M. Edge-Assisted Control for Healthcare Internet of Things: A Case Study on PPG-Based Early Warning Score. ACM Trans. Internet Things 2020, 2, 1–21.
[6] Atzori, L.; Iera, A.; Morabito, G. The internet of things: A survey. Comput. Netw. 2010, 54, 2787–2805.
[7] Steinhubl, S.R.; Muse, E.D.; Topol, E.J. The emerging field of mobile health. Sci. Transl. Med. 2015, 7, 283rv3.
[8] Kumar, S.; Gupta, Y.; Mago, V. Health-monitoring of pregnant women: Design requirements, and proposed reference architecture. In Proceedings of the 2019 16th IEEE Annual Consumer Communications & Networking Conference (CCNC), Las Vegas, NV, USA, 11–14 January 2019; pp. 1–6.
[9] Setse, R.; Grogan, R.; Pham, L.; Cooper, L.A.; Strobino, D.; Powe, N.R.; Nicholson, W. Longitudinal study of depressive symptoms and health-related quality of life during pregnancy and after delivery: The Health Status in Pregnancy (HIP) study. Matern. Child Health J. 2009, 13, 577–587.
[10] Kalafat, E.; Leslie, K.; Bhide, A.; Thilaganathan, B.; Khalil, A. Pregnancy outcomes following home blood pressure
[11] Negrato CA, Mattar R, Gomes MB (2012) Adverse pregnancy outcomes in women with diabetes.
[12] Okubo, H, Crozier, SR, Harvey, NC et al. (2014) Maternal dietary glycemic index and glycemic load in early pregnancy are associated with offspring adiposity in childhood: the Southampton women's survey. Am J Clin Nutr 100, 676–683.
[13] Suez, J, Korem, T, Zilberman-Schapira, G etal. (2015) Non-caloric artificial sweeteners and the microbiome: findings and challenges. Gut Microbes 6, 149–155.
[14] Donazar-Ezcurra, M, Lopez-DelBurgo, C, Martinez-Gonzalez, MA et al. (2017) Soft drink consumption and gestational diabetes risk in the sun project. Clin Nutr 37, 638–645.
[15] McDonald SD, Malinowski A, Zhou Q, Yusuf S, Devereaux PJ. Cardiovascular sequelae of preeclampsia/eclampsia: a systematic review and meta-analyses. Am Heart J. 2008; 156:918–930.
[16] van Rijn BB, Bruinse HW, Veerbeek JH, Post Uiterweer ED, Koenen SV, van der Bom JG, Rijkers GT, Roest M, Franx A. Postpartum circulating markers of inflammation and the systemic acute-phase response after early-onset preeclampsia. Hypertension. 2016; 67:404–414
[17] Kvehaugen AS, Dechend R, Ramstad HB, Troisi R, Fugelseth D, Staff AC. Endothelial function and circulating biomarkers are disturbed in women and children after preeclampsia. 2011; 58:63–69.
[18] Romundstad PR, Magnussen EB, Smith GD, Vatten LJ. Hypertension in pregnancy and later cardiovascular risk: common antecedents?Circulation. 2010; 122:579–584.