International Journal of Trend in Scientific Research and Development (IJTSRD)
Special Issue on Advancements and Emerging Trends in Computer Applications - Innovations, Challenges, and Future Prospects
Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

# AI-Powered Maternal Health Monitoring Device for Real-Time Tracking of Prenatal Well-Being

**Mansi. D. Wandhare**

Department of Computer Application, G. H. Raisoni University, Amravati, Maharashtra, India

**ABSTRACT**

Mother health includes health during pregnancy and childbirth. Each step during pregnancy should have a positive experience and ensure that their women and their children reach their entire ability in health and well-being. However, it cannot be achieved always. According to the UNFPA (UN Population Fund), around 800 women die each day due to pregnancy and childish reasons, so it is important to monitor the health of the mother and fetus during pregnancy. Many portable sensors and equipment are designed to monitor both fetal and mother's health and physical activities and reduce the risk during pregnancy. Some wearables monitor fetal ECG or heart rate and movement, while others focus on the mother's health and physical activities. This study presents a systematic review of these analyses. Twelve scientific articles were reviewed to address three research questions oriented to sensors and methods of data acquisition, processing methods of the acquired data, and detection of the activities or movements of the fetus or the mother. Based on these findings, we discuss how sensors can help effectively monitor maternal and fetal health during pregnancy. We have observed that most of the wearable sensors were used in a controlled environment. These sensors need more testing in free-living conditions and to be employed for continuous monitoring before being recommended for mass implementation.

***KEYWORDS:*** *FECG, FHR, fetal movement, m-health, PPG, wearable sensors*

## I. INTRODUCTION

All over the world, over 200 million people experience annual pregnancy. There are around 140 million births per year. The relationship between births participated by skilled health workers was less than 81% in 2019. Factors affecting a mother's health can be external, environmental, risk, physical, and practical factors. Careful monitoring of significant signs and physical activities is necessary to ensure the health and safety of the mother and fetus during pregnancy. This monitoring is often the first step in the identity of pregnancy disorders and risks, which provides an opportunity for rapid and effective interventions to prevent mother and newborn disease and mortality.

In the traditional medical system, patients make appointments with doctors if symptoms appear and follow their advice until the problem resolves; this is often expensive and time-consuming due to frequent and scheduled visits to the experts. The current pattern for prenatal care includes 15 face-to-face trips with suppliers. The content of these trips includes important health services, risk assessment, patient training and the creation of trust between the patient and the supplier. In this traditional system, women miss out on important opportunities to monitor and understand their health and the health of their newborns. With the recent advances in communications and technology, many devices and sensors have been developed to remotely monitor health conditions and track health parameters in daily environments. Wearable sensors, m-health technologies, mobile apps, and other wireless devices such as smartwatches open new possibilities for monitoring behavioral and physiological phenomena. These devices allow blood glucose level, blood pressure, heart rate, and other biometric data to be consistently measured. The realtime information is then transferred to the healthcare providers. These devices facilitate two -way communication between the doctor and the patient. In general, it is not an easy task to identify physical activity based on the portable sensor and includes many challenges. For example, sensor placement on the body affects the physical recognition rate, where a certain physical activity may be more recognizable with the sensors worn on specific body parts than others. Therefore, a clear understanding of sensor principles and proper selection of wearables is essential for effective monitoring. Several recent research studies have focused on the use of application-specific wearables to monitor maternal health during pregnancy. This review is intended to provide a systematic evaluation of wearable sensors for monitoring maternal health in daily life. The focus is to summarize the effectiveness and limitations of the state-of-the-art methods and to find the scope for future research in this area.

## II. RELATED WORK

Several studies and projects have been conducted to improve maternal health monitoring using technology, data analytics, and digital healthcare solutions.

For instance, Bloomlife (2016) developed a portable patch which monitors mother's contractions and helps predict preterum work. The unit provides real -time response to expectant mothers and health professionals, functions include are contraction tracking, fetal movement monitoring, data visualization, and remote monitoring.

Similarly, Nanyang Technological University, Singapore (2019) proposed a Internet of Things (IoT) -based mother's health monitoring, it collects real-time health data using the portable sensor in the IoT-powered system. It monitors important signs such as heart rate, blood pressure and fetal speed, warns doctors in case of deviations.

Moreover, Stanford el at. (2020) AI-based system predicts the risk of tirk lampsia using Electronic Health Records (EHRs). The model helps identify high -risk pregnancies and provides preliminary intervention recommendations. A

research study bt MIT and Harvard Medical Schools who developed a machine learning algorithm to detect pregnancy complications such as pregnancy diabetes and high blood pressure. The system analyzes maternal health records and provides initial warnings for the necessary medical intervention.

Philips Pregnancy+ (Global, 2020), this mobile application supports mothers expected with health tracking, planning of medical appointments, insights into fetal development and education related to pregnancy. This is integrated with smart sensors to monitor mother's vital, and provide initial warning signals on potential complications.

Stanford University's AI-based Preclampsia Predicter (USA, 2020), researchers at Stanford University developed an AI model that predicts the before - Priclampsia risk week in advance by analyzing maternal health journals and portable unit data. The study reported an improvement of 40% in early diagnosis compared to traditional methods.

NHS Digital Maternity Record (UK, 2018), the National Health Service (NHS) in the UK introduced a digital maternity system to improve mother's health tracking, so that doctors, midwives and patients can reach pregnancy - related health data safely. System Increase Care Coordination and Reduces Medical Errors.

## III. DATA AND SOURCES of DATA

### A. Personal and demographic data

- Name, age, address, contact information

### B. Medical History and Prantal Data

- Previous pregnancy, spontaneous abortion or position
- Pre-xistent medical conditions (eg diabetes, hypertension) Hydrophical

### C. Important characters and diagnostic data

- Blood pressure, heartbeat, oxygen saturation, Smell
- Temperature and other physical health indicators

### D. Blood tests and laboratory data

- Hemoglobin levels (detection of anemia)
- Blood sugar level (pregnancy diabetes screening)
- Infectious Disease Investigation (HIV, Hepatitis B, syphilis)
- Hormonal levels (progesterone, hcg)

### E. Embryo and ultrasound data

- Fetal heart rate and movement monitoring
- Growth parameter (head circumference, Lower length)

## IV. RESEARCH METHODOLOGY

The Maternal Wellness Monitoring System follows a established and era-driven technique to make certain comprehensive maternal healthcare via real-time health monitoring, predictive analytics, and digital fitness interventions. The method consists of machine design, facts series, AI-primarily based hazard assessment, telemedicine integration, information safety, pilot implementation, and non-stop assessment.

The first phase entails designing and growing the device architecture, figuring out key purposeful and non-functional requirements. The gadget is designed to combine wearable IoT gadgets, a cellular health (mHealth) software, AI-driven analytics, and a centralized digital health record (EHR) machine. A secure and scalable cloud-based totally infrastructure is set up to keep and control maternal health records, making sure seamless get entry to for healthcare carriers and sufferers.

The mother's welfare monitoring system follows a structured and technology -driven approach to ensure real - time health tracking, future indication analysis and broad mothers health services through digital health interventions. The function includes system design, data collection, AI-based risk assessment, telemedicine integration, data security, pilot implementation and continuous evaluation.

The first phase involves designing and developing system architecture, identifying important functional and non-functional needs. The system is designed to integrate the portable IoT unit, a mobile health application, AI-driven analysis and a centralized electronic health record (EHR) system. A safe and scalable cloud -based infrastructure is established to store and manage health data for the mother, ensuring spontaneous access to health professionals and patients.

In the information series section, actual-time maternal fitness parameters together with blood strain, heart rate, oxygen ranges, fetal actions, and glucose ranges are accrued using wearable sensors and cellular health programs. Expectant moms regularly replace their health popularity via mobile apps, and community medical examiners assist in facts collection for ladies in faraway regions. This statistics is transmitted to a secure cloud database for similarly analysis.

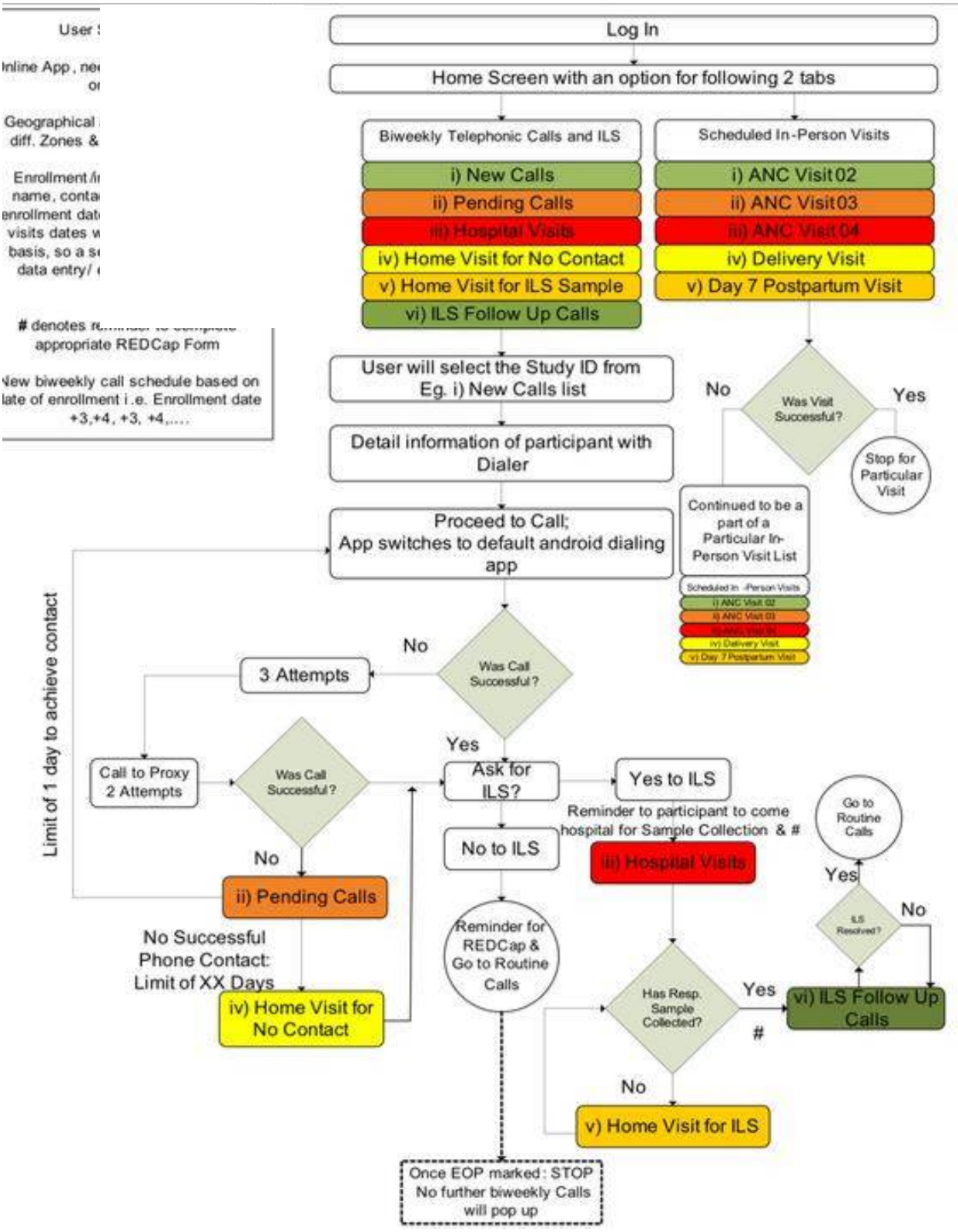


**Fig. Flow Chart**

**Step 1: Log In**

- The user log in the system, which has two main tabs:

1. Biweekly Telephonic Calls and ILS : It includes new calls, pending calls, hospital visits, home visit for no contact, home visit for ILS sample, ILS follow-up calls.
2. Scheduled In-Person Visits : It includes ANC visit 02, ANC visit 03, ANC visit 04, delivery visit, day 7 postpartum visit.

**Step 2: Selecting a Study ID**

- The user selects a Study ID from the "New Calls" list.
- The system displays detailed participant information along with a dialer.

**Step 3: Call Process**

- The system switches to default auto-dialing.
- The user attempts to contact the participant (up to 3 attempts).

**Step 4: Call Outcome**

**1. Successful Call**

- The user asks if the participant is willing to provide an ILS sample.
- If yes, the participant is reminded to visit the hospital for sample collection.
- If no, the user records this information in the system and proceeds to routine calls.

**2. Unsuccessful Call**

➢ If all 3 attempts fail:

- A proxy contact attempt is made.
- If unsuccessful:
  - The participant is marked under Pending Calls.
  - If no successful contact occurs within a specified number of days, the participant is scheduled for a Home Visit for No Contact.

**Step 5: Hospital Visit for Sample Collection**

➢ If the participant agrees to provide an ILS sample:

- They visit the hospital.
- If the sample is collected, the system marks it and continues with routine calls.
- If the sample is not collected, the participant is scheduled for a Home Visit for ILS Sample.

**Step 6: In-Person Visits**

➢ If a participant has an in-person visit scheduled (e.g., ANC Visit, Delivery Visit, Postpartum Visit):

- The visit is conducted.
- If successful, it is recorded and stopped for that visit.
- If unsuccessful, the participant is moved to the pending list for further follow-ups.

**Step 7: Biweekly Calls Continuation**

- Routine biweekly follow-up calls continue until the End of Participation (EOP) is marked.
- Once EOP is marked, no further biweekly calls will be conducted.

## V. RESULT AND DISCUSSION

To monitor a mother's health during pregnancy and after the birth of a baby is required to keep both her and her child safe. With regular control of major health factors such as physical condition, mental welfare and daily habits, doctors can see possible problems quickly and take measures to prevent complications.

**Physical health check**

Before the doctor becomes severe, the pregnancy monitors important health signs such as blood pressure, heartbeat, and blood sugar level to detect conditions such as diabetes and hypertension (Spirklampsia). It also ensures mothers eat the right nutrients food to prevent problems such as anemia. It is also important to monitor weight because obtaining too much or too little can affect both mother and child's health.

**Mental and emotional welfare**

Mental welfare monitoring includes mental health problems such as prenatal and postpartum depression or screening for anxiety. Psychological support and early intervention programs can significantly improve maternal welfare, reducing stress-related complications that can affect fetal development.

**Lifestyle and environmental factors**

Sleep patterns, physical activity, and exposure to harmful substances (such as tobacco or alcohol) allow healthcare professionals to recommend individual strategies for better mother's health. In addition, evaluation of socio-economic factors such as health care and access to social aid systems helps address inequalities in maternal care.

**Results and benefits**

Effective mothers Welfare monitoring leads to low frequencies of mortality from mother and newborn, reduced pregnancy complications and improves birth results. By addressing potential health problems quickly, mothers may experience a steady pregnancy, safe distribution and a healthy birth time. Continuous education and support to make appropriate health decisions to women, eventually to contribute to the good of the morsions and children.

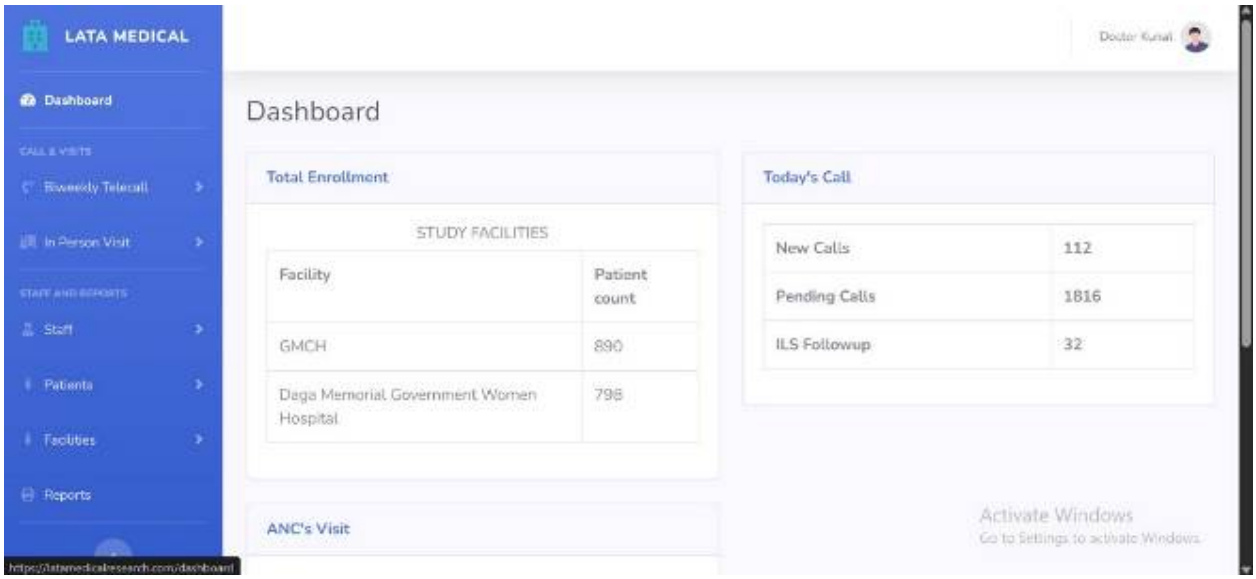


**Fig: Dashboard**

Mother's welfare monitors have become important tools in modern health care, which helps to improve pregnancy results by continuously monitoring and potentially detection of potential complications. These surveillance use large mothers and foster health indicators such as blood pressure, heartbeat, fetal speed and uterine contractions use portable technology, mobile applications and external health services. Their ability to provide real -time data allows both mothers and health professionals to respond immediately to any deviations, which reduces the risk associated with pregnancy and childbirth.

One of the biggest benefits of mother's welfare monitor is his role in early intervention. Conditions such as prack lamps, pregnancy diabetes and fetal crisis can be quickly identified, which can lead to timely medical intervention and better results for both mother and child. In addition, remote monitoring has made birth care more accessible, especially for people in rural or signed areas where frequent hospital visits can be challenging.

In addition to physical health, the mother's welfare monitor is now now mental health tracking facilities to address conditions such as birth depression and anxiety. By assessing mood patterns and providing notifications, these systems help improve emotional welfare for new mothers.

However, there are challenges in ensuring access and strength for these techniques. Problems such as privacy, cost and user education should be solved to maximize the benefits.

Finally, the mother's welfare monitor changes in health services by promoting initial detection, access and general welfare. As technology goes on, these monitors will play an important role in improving mother's and newborn health results worldwide.

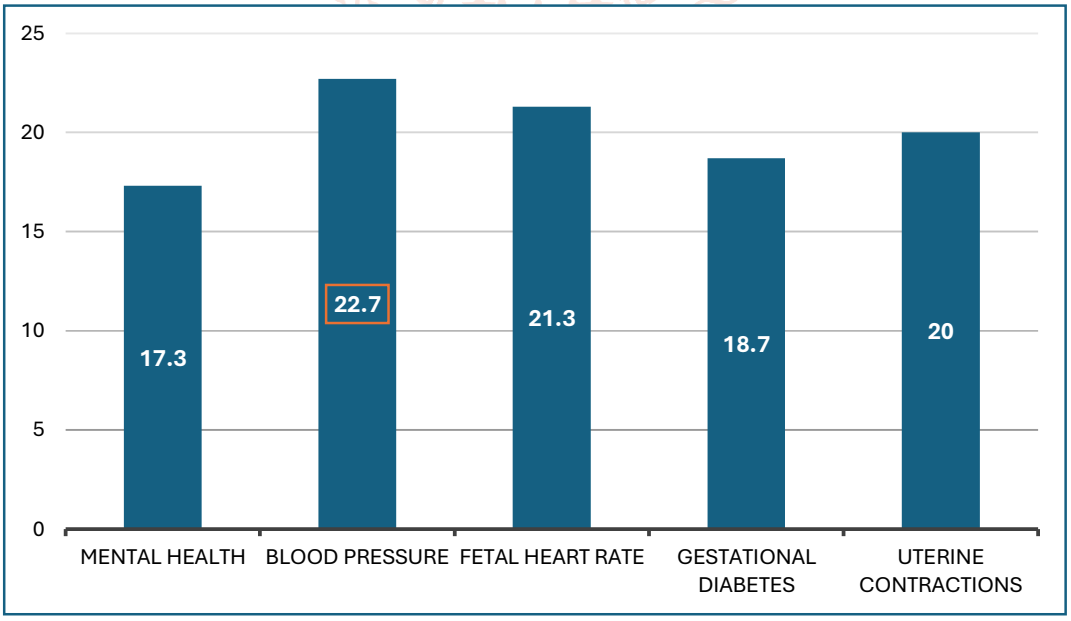


**Fig. Impact of Maternal Wellness Monitors on Pregnancy Outcomes**

Here is a graphical representation of the impact of maternal wellness monitors on pregnancy outcomes. The bar chart illustrates the percentage improvement in different maternal health monitoring aspects, such as blood pressure monitoring, fetal heart rate tracking, and mental health tracking. Let me know if you need any modifications or additional insights!

## VI. CONCLUSION

Mother's welfare monitor has revolutionized maternal health services by continuous and real -time monitoring of pregnant women and postpartum persons. These advanced systems, including portable equipment, mobile applications and clinical surveillance solutions, track large health parameters such as blood pressure, heartbeat, fetal speed, contraction of the uterus and mental welfare. By providing initial detection of potential complications, these monitors play an important role in reducing mother and infant mortality and improving the total pregnancy results.

One of the main benefits of mother's welfare monitor is their ability to quickly detect health risks. Conditions such as prack lampsia, gestational diabetes and birth depression can be identified before growing in serious complications. For example, a sudden increase in blood pressure may indicate the outbreak of preclaming, so that health professionals can intervene immediately. Similarly, tracking of fetal movement and heartbeat can help detect signs of fetal crisis, ensuring timely medical care. This initial intervention capacity significantly reduces the possibility of mother and newborn disease and mortality.

Another great advantage of mother's welfare monitor is their role in strengthening mothers with knowledge and control over their health. With access to real -time data through mobile apps and portable devices, the expected mothers can track their important, identify warning signs and take active measures. This self -detection not only improves mother's confidence, but also encourages prenatal care and compliance with medical recommendations. In addition, health professionals can monitor patients externally, which can make birth care more accessible, especially for those in remote or understanding areas where the hospital trip can often be challenging.

Integration of artificial intelligence (AI) and machine learning into mother's welfare monitoring systems have further improved efficiency. The AI-operated analysis can identify the pattern and predict potential complications before it occurs. Telemedicine and remote consultation, activated by these monitors, ensure that health professionals can provide timely guidance without the need for leeks. This digital change in the mother's health care system improves the quality of care by reducing the cost of health care and strain on medical facilities.

Mental Health Monitoring is another important aspect of mother's welfare monitor. Postpartum depression and anxiety are common, but there are often weak conditions that can adversely affect both mother and child. Advanced mother's welfare monitoring systems now include the assessment of mental health and moody properties that help identify the emotional crisis. This gives time for psychological support and intervention, improves the general welfare of new mothers.

## VII. REFERENCES


[1] Sedgh, G.; Singh, S.; Hussain, R. Intended and unintended pregnancies worldwide in 2012 and recent trends. Stud. Fam. Plan. 2014, 45, 301–314.

[2] Maternal Health. Available online: https://www.who.int/health-topics/maternal-health (accessed on 14 October 2022).

[3] Runkle, J.; Sugg, M.; Boase, D.; Galvin, S.L.; C Coulson, C. Use of wearable sensors for pregnancy health and environmental monitoring: Descriptive findings from the perspective of patients and providers. Digit. Health 2019, 5, 2055207619828220.

[4] Ullah, F.; Iqbal, A.; Iqbal, S.; Kwak, D.; Anwar, H.; Khan, A.; Ullah, R.; Siddique, H.; Kwak, K.-S. A Framework for Maternal Physical Activities and Health Monitoring Using Wearable Sensors. Sensors 2021, 21, 4949.

[5] Penders, J.; Altini, M.; Van Hoof, C.; Dy, E. Wearable Sensors for Healthier Pregnancies. Proc. IEEE 2015, 103, 179–191.

[6] MacDorman, M.F.; Declercq, E.; Cabral, H.; Morton, C. Recent Increases in the U.S. Maternal Mortality Rate: Disentangling Trends From Measurement Issues. Obstet. Gynecol. 2016, 128, 447–455.

[7] Ryu, D.; Kim, D.H.; Price, J.T.; Lee, J.Y.; Chung, H.U.; Allen, E.; Walter, J.R.; Jeong, H.; Cao, J.; Kulikova, E.; et al. Comprehensive pregnancy monitoring with a network of wireless, soft, and flexible sensors in high- and low-resource health settings. Proc. Natl. Acad. Sci. USA 2021, 118, e2100466118.

[8] Food and Agriculture Organization of the United Nations. MDG 5: Improve maternal health|Sustainable Development Goals. Available online: https://www.fao.org/sustainable-development-goals/mdg/goal-5/en/ (accessed on 9 November 2022).

[9] Kashem, M.A.; Seddiqui, M.H.; Moalla, N.; Sekhari, A.; Ouzrout, Y. Review on Telemonitoring of Maternal Health care Targeting Medical Cyber-Physical Systems. arXiv 2016, arXiv:1607.07712.

[10] Balakrishna, C.; Rendon-Morales, E.; Aviles-Espinosa, R.; Dore, H.; Luo, Z. Challenges of Wearable Health Monitors: A Case study of Foetal ECG Monitor. In Proceedings of the 2019 Global IoT Summit (GIoTS), Aarhus, Denmark, 17–21 June 2019; pp. 1–6.

[11] Remote Pregnancy Monitoring Challenge|Maternal and Child Health Bureau Grand Challenges (MCHB—GC). Available online: https://mchbgrandchallenges.hrsa.gov/challenges/remote-pregnancy-monitoring (accessed on 24 October 2022).

[12] Hossain, D.; Imtiaz, M.H.; Sazonov, E. Comparison of wearable sensors for estimation of chewing strength. IEEE Sens. J. 2020, 20, 5379.

[13] Imtiaz, M.H.; Ramos-Garcia, R.I.; Senyurek, V.Y.; Tiffany, S.; Sazonov, E. Development of a Multisensory Wearable System for Monitoring Cigarette Smoking Behavior in Free-Living Conditions. Electronics 2017, 6, 104.

[14] Imtiaz, M.H.; Ramos-Garcia, R.I.; Wattal, S.; Tiffany, S.; Sazonov, E. Wearable Sensors for Monitoring of Cigarette Smoking in Free-Living: A Systematic Review. Sensors 2019, 19, 4678.

[15] Pregnancy Wearable Technology; An Advanced Step in Pregnancy Health. 9 November 2018. Available online: https://techengage.com/pregnancy-wearable-technology/ (accessed on 20 November 2022).