

DEVELOPMENT OF INTEGRATED WEARABLE DEVICE FOR REMOTE MONITORING OF PREGNANT WOMEN IN GHANA

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PRESENTATION OUTLINE

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IMAGES OF PREGNANT WOMEN



BACKGROUND

- ❖ **Monitoring of pregnant women is an important issue in maternal care due to possibility of complications**
- ❖ **Pregnant women are required to regularly visit a clinic for antenatal care.**
- ❖ **Pregnant women are monitored for critical parameters like; body temperature, blood pressure, protein in the urine, heart rate, blood glucose levels and oxygen saturation which help in assessing the health of both mother and baby.**



BACKGROUND

- ❖ **Body Temperature:** Detects fever or infections that could harm both mother and fetus.
- ❖ **Blood Pressure and Protein in Urine:** Monitors for hypertension disorders like preeclampsia to prevent complications.
- ❖ **Oxygen Saturation:** Tracks oxygen levels to prevent anemia and maternal respiratory issues.
- ❖ **Heart Rate:** Assesses cardiovascular health to ensure the heart is coping with pregnancy demands.
- ❖ **Blood Glucose Level:** Identifies gestational diabetes to manage risks for mother and baby.



BACKGROUND

- ❖ **Potential dangers of not monitoring can lead to critical challenges such as; preeclampsia, anemia, low birth weight and developmental delays and ultimately lead to death.**
- ❖ **Leveraging on technology that can support remote monitoring to acquire all the key parameters and provide rapid decision could help save mother and baby in real time.**



PROBLEM STATEMENT

- ❖ According to World Health Organization(WHO), over 40% of pregnancies in developing countries face significant health risks, making pregnancy complications a major public health concern. ^[2]
- ❖ Reports ^[2] reveal that, in Ghana, 12% of female deaths (ages 15-49) in the previous 5 years stem from pregnancy complications, with 62% due to late or poor medical intervention.
- ❖ Barriers of distance, transportation cost and time constraints hinder pregnant women from undergoing regular antenatal care, hence increasing maternal risks.



PROBLEM STATEMENT

- ❖ **Infrequent visitation to antenatal care lead to late detection of pregnancy complications such as preeclampsia and anemia lowers chances of survival of pregnant women.**



RELEVANCE OF WORK

- ❖ **Early detection of pregnancy complications hence reducing maternal mortality**
- ❖ **Equip pregnant women with tools to monitor and manage their health**
- ❖ **Continuous data collection and visualization empower doctors to make informed, data-driven decisions rather than relying solely on periodic observations**
- ❖ **Ease of pressure on antenatal clinics due to reduced visitations**



OBJECTIVES

- ❖ **To develop an integrated system consisting of a wearable device and a mobile application to continuously monitor, detect and trigger alerts in event of abnormality.**
- ❖ **To train a machine learning model for risk prediction of pregnancy complications like preeclampsia and anemia long before standard detection window.**
- ❖ **To develop a user-friendly interface system to acquire and visualize information for processing by the system.**



EXISTING SOLUTIONS

- (1) **A Comprehensive Framework for Wearable Module for Prenatal Health Monitoring and Risk Detection(2024)** [\[1\]](#)

GOAL: A system to continuously monitor vitals of pregnant women throughout pregnancy and send SMS to healthcare providers in event of any anomaly.

TECHNIQUE: Threshold values are set in the ESP-32 microcontroller and comparison is done with values captured by the wearable device. Body temperature, blood glucose, blood pressure, oxygen saturation, heart rate, fetal movement and falls of pregnant woman were monitored.

EXISTING SOLUTIONS

RESEARCH GAP: No mechanism for predictive analysis of patient's vitals to forewarn a risk of complication or possible illness of mother

EXISTING SOLUTIONS

(2) Explainable Early Prediction of Gestational Diabetes Biomarkers by Combining Medical Background and Wearable Devices: A Pilot Study With a Cohort Group in South Africa(2024) [\[5\]](#)

GOAL: A wrist-worn device that forecasts biomarkers 13 to 16 weeks prior to the Gestational Diabetes Mellitus(GDM) screening test done 24-28 weeks in pregnancy.

TECHNIQUE: Glucose monitoring devices, a wristband for activity detection, and medical background data were fed into a ML model to predict possible occurrence of GDM.

RESEARCH GAP: Limited scope to GDM.



EXISTING SOLUTIONS

(3)Health Monitoring Of Expecting Mothers Using Multiple Sensor Approach: "Preg Care" (2020) [6]

GOAL: A hand/wrist-worn system comprising provides complete health monitoring during the pregnancy period.

TECHNIQUE: Body temperature, glucose rate detection, heart rate, sudden fall detection and anemia status(using python-based image processing) are monitored throughout gestational period. Alert systems are implemented.

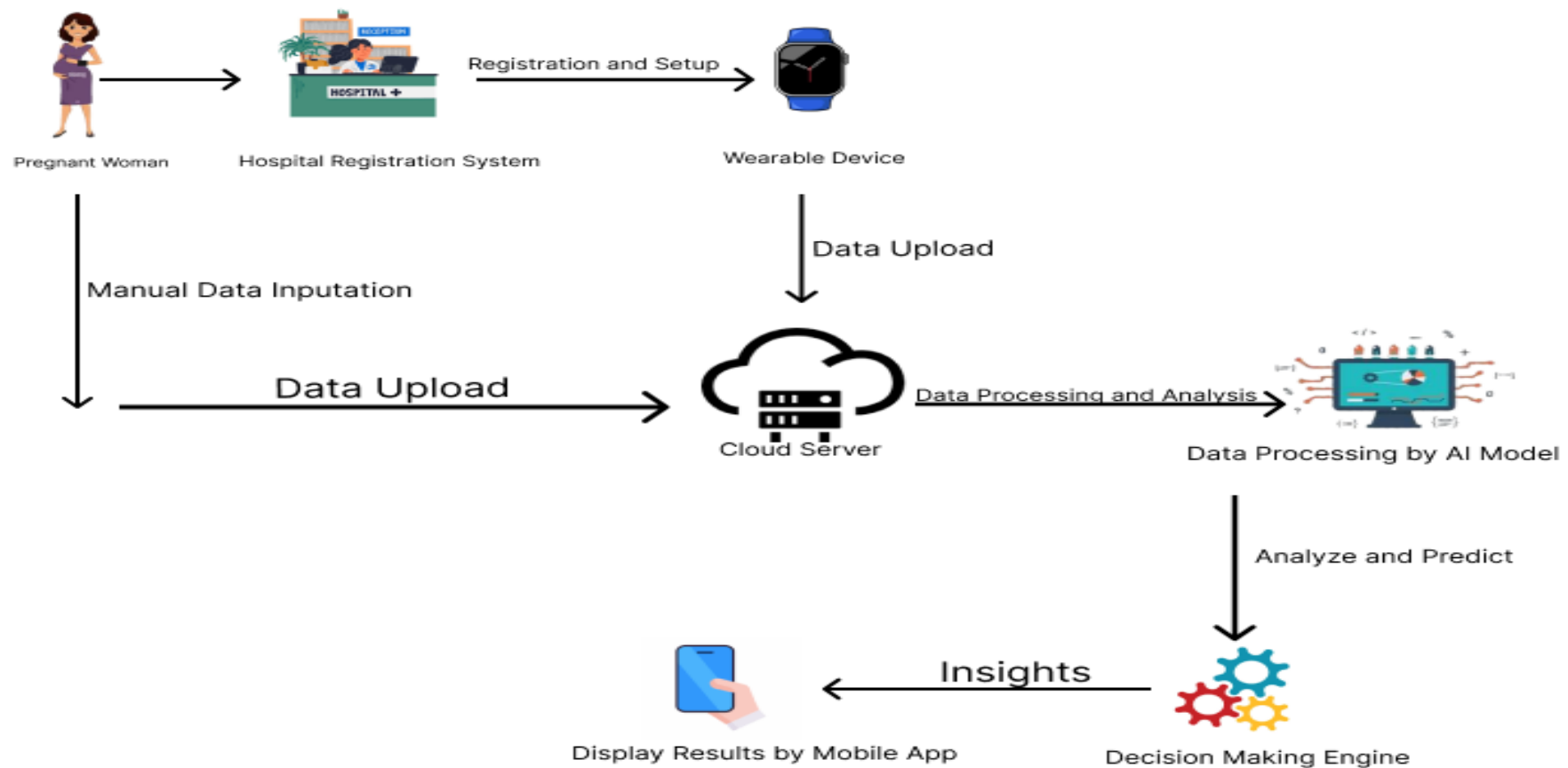
RESEARCH GAP: No data security measures are implemented.



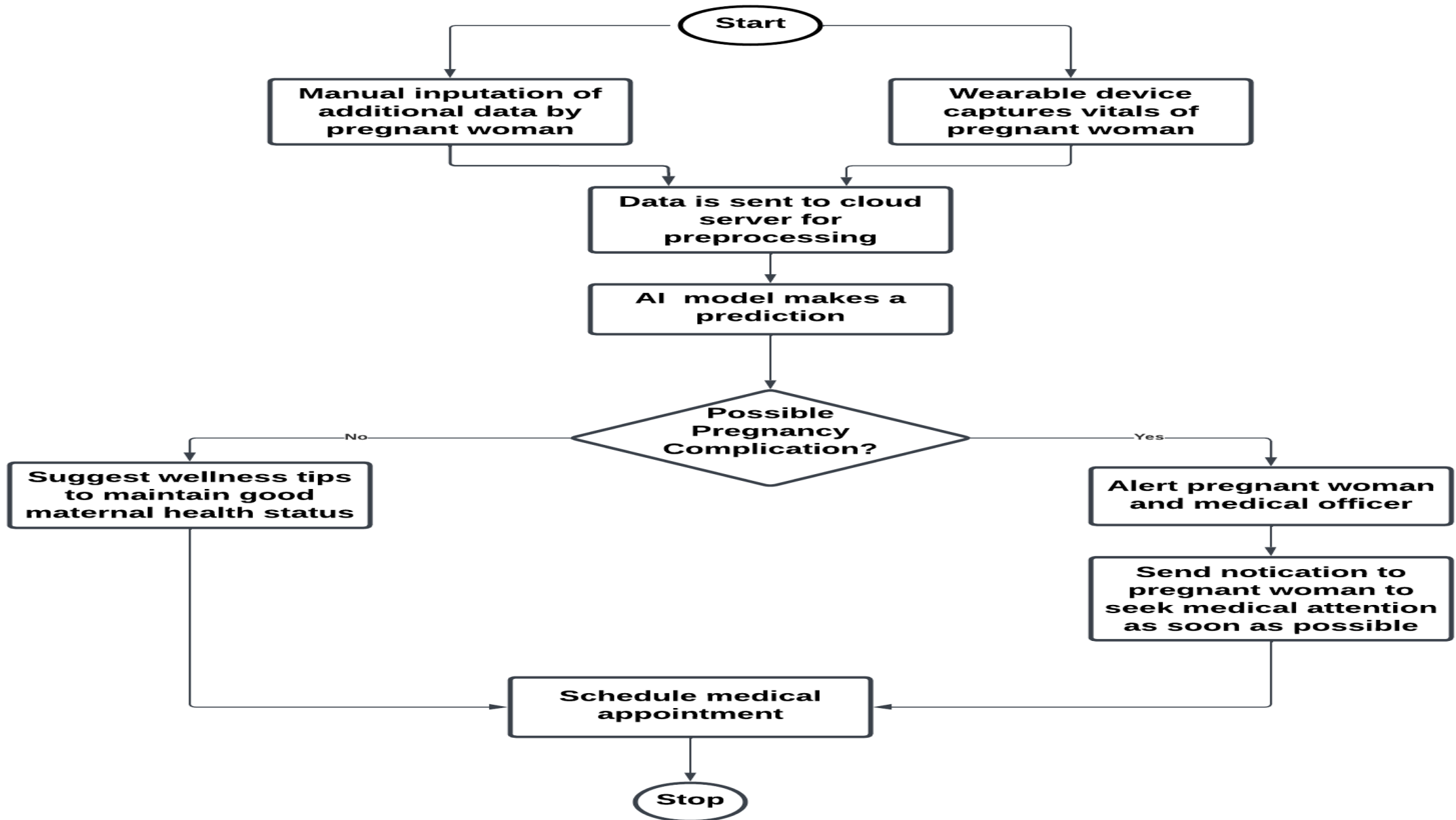
PROPOSED METHODOLOGY

- ❖ Data of vitals measured are captured by the wrist-worn wearable device and additional data such as protein in urine are manually inputted into a mobile app and sent to the cloud.
- ❖ Data preprocessing and feature selection occurs in the cloud. These are fed into a machine learning model trained to predict pregnancy complications weeks ahead of standard detection window and alert a pregnant woman and doctor if anomaly is detected in vitals.
- ❖ Mobile app provides a dashboard each for the pregnant woman and the doctor to visualize vitals and receive alerts in event of anomaly.

SYSTEM ARCHITECTURE



OPERATIONAL FLOW DIAGRAM



HARDWARE FUNCTIONAL REQUIREMENTS

- ❖ The wearable must continuously collect and transmit vitals data to cloud every 30 seconds.
- ❖ The device should store essential data temporarily.
- ❖ The wearable must be designed to operate on low power, with a focus on battery optimization.
- ❖ All health data transmitted from the device to the mobile application or cloud platform must be encrypted.

SOFTWARE FUNCTIONAL REQUIREMENTS

- ❖ **The app should present data visually to make it easy for users to track changes in their health over time.**
- ❖ **In case of anomalies in data, the AI should automatically trigger an alert to both pregnant woman and medical officer.**
- ❖ **The app should provide functionality for users to back up their health data and retrieve it if needed.**
- ❖ **The app should allow for Patient-Doctor appointment booking**

HARDWARE NON-FUNCTIONAL REQUIREMENTS

- ❖ **The wearable device should be lightweight and comfortable to wear for long period.**
- ❖ **The wearable should require minimal maintenance, with replaceable parts such as batteries that are easily accessible and affordable to users.**
- ❖ **The wearable must be durable hence water and shock resistance.**
- ❖ **Cross-platform compatibility hence easy communication**

SOFTWARE NON-FUNCTIONAL REQUIREMENTS

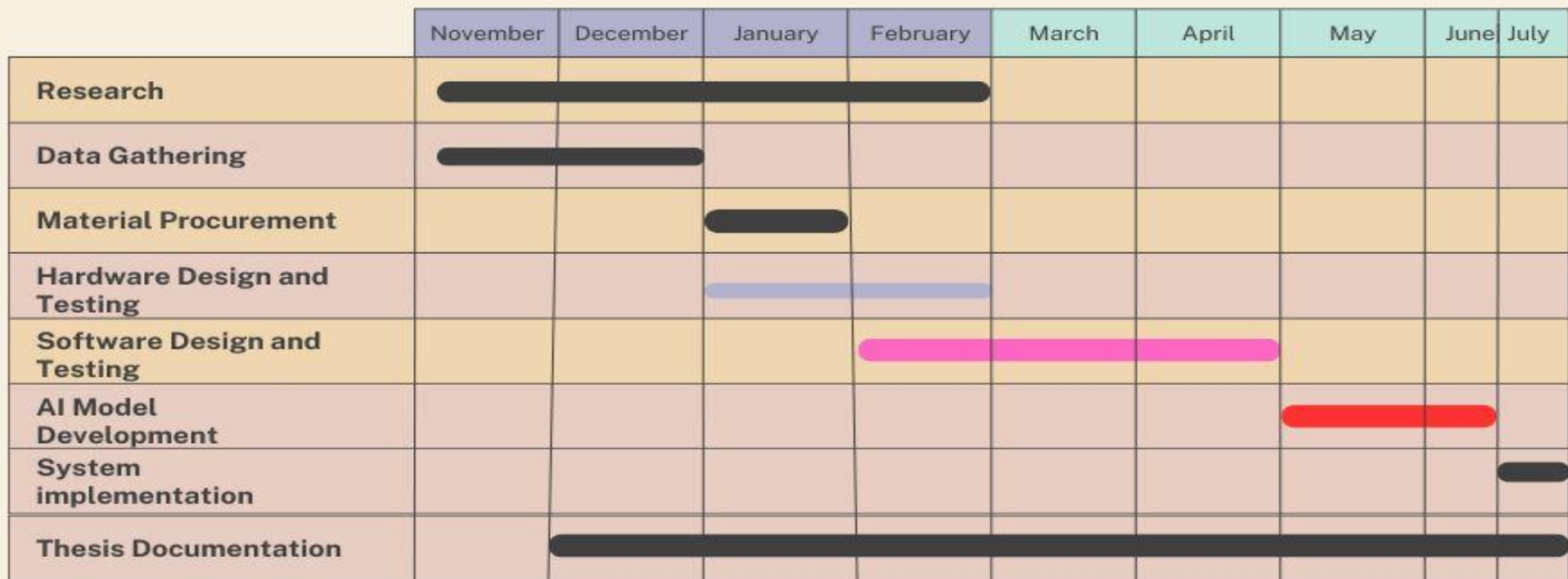
- ❖ **User-friendly and intuitive mobile interface**
- ❖ **Low latency between wearable device, cloud and mobile application**
- ❖ **Cross-platform support on the mobile app**
- ❖ **Scalability to accommodate a growing user base**

RESOURCE REQUIREMENTS

- ❖ DS18B20 temperature sensor
 - ❖ MAX30100 sensor
 - ❖ Withings BPM Connect
 - ❖ GlucoWise
 - ❖ ESP32 microcontroller
 - ❖ AWS(Amazon Web Services) IoT Core
 - ❖ Python
 - ❖ TensorFlow
- ❖ Flutter

PROJECT TIMELINES

PROJECT TIMELINE



CONCLUSION

- ❖ **The wearable device provides a practical solution for monitoring pregnant women in Ghana, using advanced sensors and AI to track vital signs and detect complications like preeclampsia, anemia and gestational diabetes early**
- ❖ **The mobile app enhances care for pregnant women by offering real-time data, alerts about health risks, and appointment scheduling, ensuring better communication with healthcare providers.**
- ❖ **This project addresses critical gaps in maternal healthcare and contributes to global efforts to reduce maternal and child mortality rates.**

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MISCELLANEOUS

QUESTIONS/FEEDBACK