Meena: A Smartphone Based Prenatal Health Monitoring Unit

Team Meena

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Abstract

Maternal health is the health of women during pregnancy, childbirth, and the postpartum period. Special attention should be paid to the regular medical check up of a mother during pregnancy. Otherwise both the lives of mother and child can be at great risk. The main barriers to access health information during pregnancy are as follows:

- Many duties of women at home as well as out-of-home education and employment
- Inability to make distinction between correct and incorrect information, insufficient interactions between women and healthcare providers
- Failure to access to various information resources, common complaints of pregnancy, and stress and anxiety of confronting the problems during pregnancy.

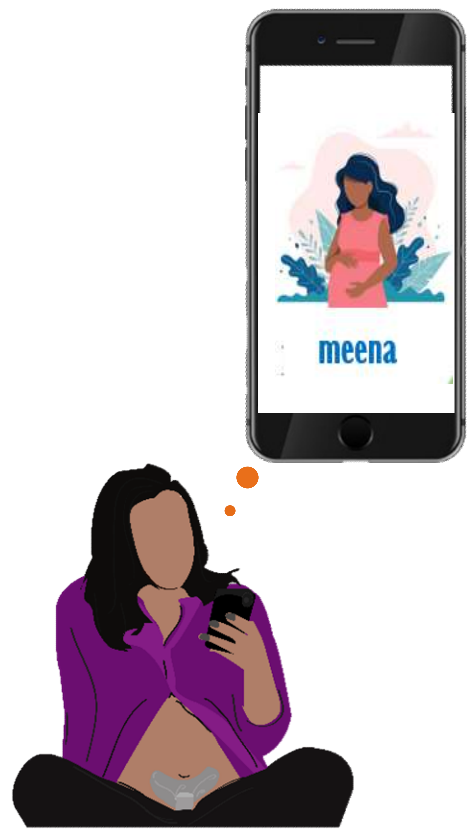
For mothers' safety purpose during pregnancy, we are providing two separate measurement methods that are implemented in AI, so the given result is as close to correct as possible. We are using signals from full 30 minutes to predict the contraction part, which is not the method used in Bangladesh hospital in general, so this is a relatively new measurement that can be easily handled by AI, which will have a revolutionary impact in our medical research. Also, we use a very small simple neural Network architecture, which has a less inference time that means the patient will be aware of her result immediately. The urinalysis will be conducted in a disposable sample jar with dipstick. In predicting the urine results, we are proposing strictly image processing method mostly done by OpenCV, so the computational cost is so less. So, this proposed method is both cheap and real time that can make aware the patient that will eventually lessen the maternity death rate. However, AI is not an actual doctor, so we are proposing to use this app as a precautionary device and consult the doctor for the actual treatment.

Abstract

Important physiological data for pregnant women are collected by sensors on peripheral devices. Examples of peripheral devices are: pulse oximeter, glucometer etc. The data are transmitted to healthcare providers or third parties using smartphone application. The data are evaluated for potential problems via rigorous signal processing, image processing and machine learning through clinical decision support algorithms, and patient, caregivers, and health providers are immediately alerted if a problem is detected. As a result, the lengthy process of visiting a diagnostic center is avoided and timely intervention ensures positive patient outcomes. The application also provide test and medication reminder alerts, and serves as a means of communication between the patient and the doctor.

Objectives

- AI prenatal health monitoring
- Home service reliability
- Ensuring basic diagnosis
- Eliminate the requirement of multiple visiting
- Precaution to maternity health



Background

➢ Maternal Healthcare Condition

Maternal health is the health of women during pregnancy, childbirth, and the postpartum period. It encompasses the health care dimensions of family planning, preconception, prenatal, and postnatal care in order to ensure a positive and fulfilling experience, in most cases, and reduce maternal morbidity and mortality, in other cases.

The United Nations Population Fund (UNFPA) estimated that 289,000 women died of pregnancy or childbirth related causes in 2013. These causes range from severe bleeding to obstructed labour, from delayed diagnosis of prenatal eclampsia, to unwise activities during pregnancy all of which have highly effective interventions. As women have gained access to family planning and skilled birth attendance with backup emergency obstetric care, the global maternal mortality ratio has fallen from 380 maternal deaths per 100,000 live births in 1990 to 210 deals per 100,000 live births in 2013. This has resulted in many countries halving their maternal death rates but still there prevails many complications in pregnancy, especially in the developing countries. If these complications are detected earlier and the pregnant women are kept under constant monitoring, many women can escape the life threating conditions.

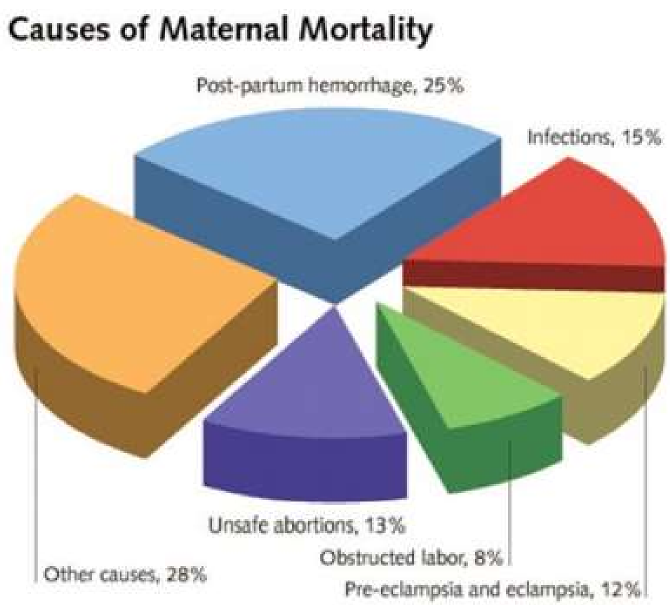


Fig. 1: Causes of Maternal Mortality around the World

Among all the reasons of maternal death, the deaths due to preeclampsia can be avoided in a large extent if proper prenatal care and constant monitoring are done to diagnose it earlier. Otherwise it may be fatal for both the mother and the baby. Though preeclampsia can become severe, if detected earlier and treated accordingly with medication to lower high blood pressure and to prevent seizures, the risk significantly lessens and the mother can deliver a healthy, matured child without any life risk.

Bangladesh, being a developing a country, has many people living below the poverty line. These people have a hard time fulfilling their basic needs let alone having proper prenatal care. Therefore, although the Maternal Mortality Rate has significantly decreased over past few decades, yet the statistics is not satisfactory and quite alarming.

Table : Maternal Health Statistics in BD (2016)

Deaths	7,612
MM Rate	3.24%
MM Ratio	196/1,00,000 live births
World Rank	155

➢ Difficulties of Preterm Birth

An estimated 15 million babies are born too early every year. That is more than 1 in 10 babies. Approximately 1 million children die each year due to complications of preterm birth. Many survivors face a lifetime of disability, including learning disabilities and visual and hearing problems.

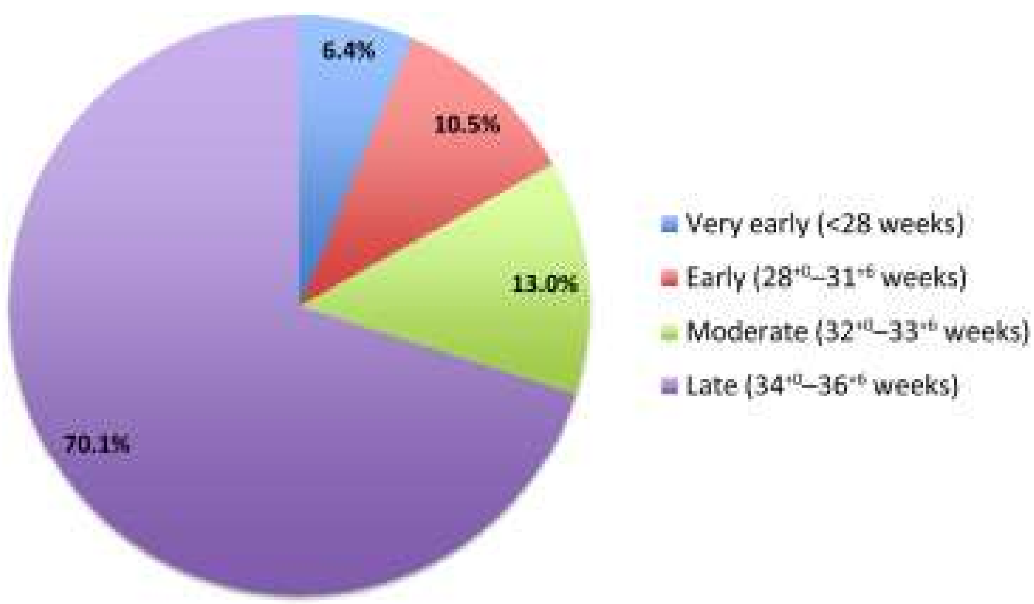


Fig. 2: Percentage for delivery of the babies with respect to delivery weeks

Globally, prematurity is the leading cause of death in children under the age of 5 years. And in almost all countries with reliable data, preterm birth rates are increasing.. Inequalities in survival rates around the world are stark. In low-income settings, half of the babies born at or below 32 weeks (2 months early) die due to a lack of feasible, cost-effective care, such as warmth, breastfeeding support, and basic care for infections and breathing difficulties. In high-income countries, almost all of these babies survive. Suboptimal use of technology in middle-income settings is causing an increased burden of disability among preterm babies who survive the neonatal period.

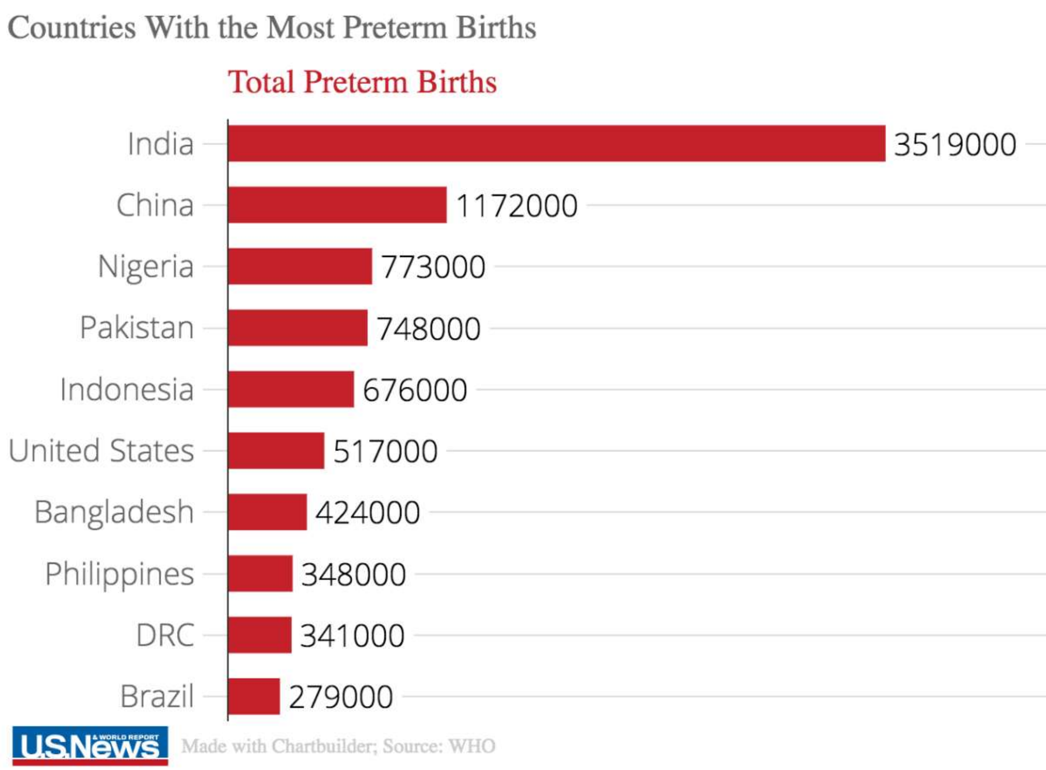


Fig. 3: Preterm Birth in numbers for different countries

More than 60% of preterm births occur in Africa and South Asia, but preterm birth is truly a global problem. In the lower-income countries, on average, 12% of babies are born too early compared with 9% in higher-income countries. Within countries, poorer families are at higher risk.

Impact

App Meena is designed on the basis of RPM with the integration of telemedicine, telecare and telehealth. Swedish researchers claim that the number of patients remotely monitored by physicians increased on 44 percent in 2016. And the rate is expected to grow. This tendency mean that patients have started to entrust their health data to mindless machines, or the reason is hiding in medical institutions' that aim at cutting the expenses and reducing the attendance at medical facilities

✓ Remote Monitoring
✓ Frequent Diagnosis at home
✓ Data Record History
✓ Low Cost
✓ Safety

- **Remote Monitoring in Real Time**: The main benefit of App Meena is its remote patient monitoring or homecare telehealth. It allows a pregnant woman to use a mobile medical device to perform routine tests and send test results to a doctor in real-time without the necessity of visiting a medical institution.

- **Relatively Lower Cost**: With home telehealth, it is not necessary to go to a clinic for prescription or ask your physician about tests results. With buying the App Meena unit once, one can conduct continuous contraction monitoring and do 30 urinalysis tests as 30 dipsticks are provided with the product package. Besides, due to the decreasing number of unnecessary hospital visits, medical institutions become less crowded and can faster admit patients who need an emergency help.

Impact

- **Safe and User Interface**: Since App Meena is a passive and non-invasive monitoring unit, it is completely safe for pregnant women. The design of the product has been done considering the safety factor of both mother and child.

- **Frequent Diagnosis at Home:** Homecare telehealth enables easy and quick communication between physicians and. Doctors can counsel the patients online with no need to wait for the appointment date. With urinalysis kit, the routine urine tests can be done at home with convenience and comfort. The contraction monitoring device is also able to inform patients about critical deterioration of child health.

- **Data Record History:** Through central server data processing, App Meena allows doctors to reach out to potential patients. The monitored data are preserved in a data 37 base with time and date for future references and if the analysis has some vital abnormality it notifies the user and has emergency provision of contacting a doctor.

Technical Framework

In this project, our aim is to develop a cost-effective, user-friendly, wearable prenatal health monitoring unit that provides at-home facilities of continuous uterine contraction monitoring and continual urinalysis for pregnant women. Two separate kits will be supplied as the product for doing the necessary monitoring and diagnosis.

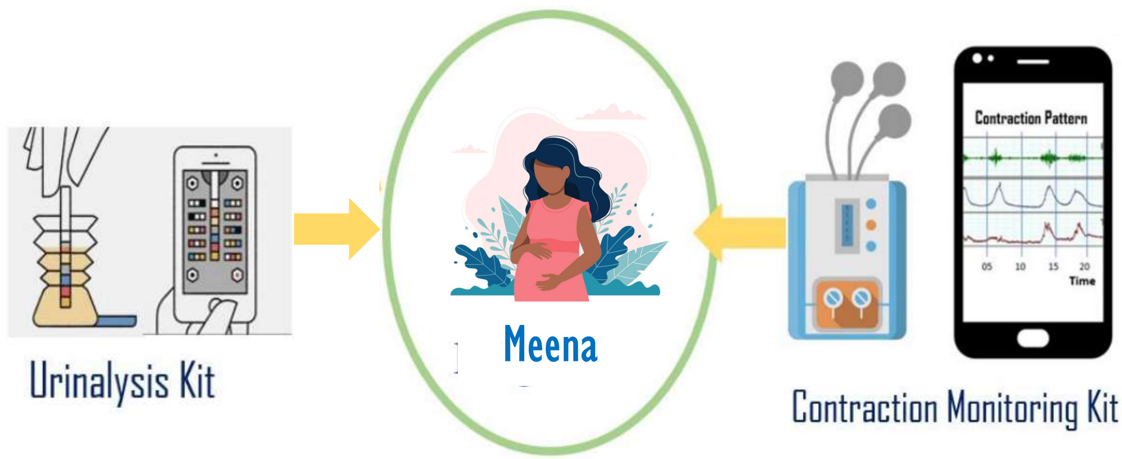


Fig. 4: Overview of the Meena app

The subjective patient data of uterine contraction and urine sample are collected by a wearable device and disposable jar with dipstick, respectively. The data are transmitted to smart phone via Bluetooth and evaluated for potential problems via rigorous signal processing, image processing and artificial intelligence based clinical decision support algorithms. Patients, caregivers, and health providers are notified if any unusual or abnormal phenomenon is detected. As a result, the lengthy process of visiting a diagnostic center is avoided and timely intervention ensures positive patient outcomes. The dedicated mobile application also provides test and medication reminder alerts, and serves as a means of communication between the patient and the doctor.

➢ Uterine Contraction Monitoring Kit

In this section, we describe the overall technical framework acting behind the uterine contraction monitoring kit, in two sub-sections, namely, hardware and software design. The proposed prototype of the kit placed on a test subject is shown in Fig. 5. The different components of the design are described in the following sub-sections.

A. Hardware Design

For designing the hardware, firstly, the electrode placement region and the wearable device dimensions are considered. Next, we have considered the data acquisition, power management, and data transmission factors.

1) User Interface of the Wearable Device : EHG signals are generally collected from the abdominal surface using four $AgCl_2$ electrodes using 3 channel configuration (Fig. 1(b)). The channels S1, S2 and S3 are respectively measured between the topmost electrodes (E2-E1), the leftmost electrodes (E2-E3), and the lower electrodes (E4-E3). Since the lower abdomen provides most significant information regrading preterm delivery, S3 is chosen as the region of interest for the placement of the sensor embedded monitoring patch.

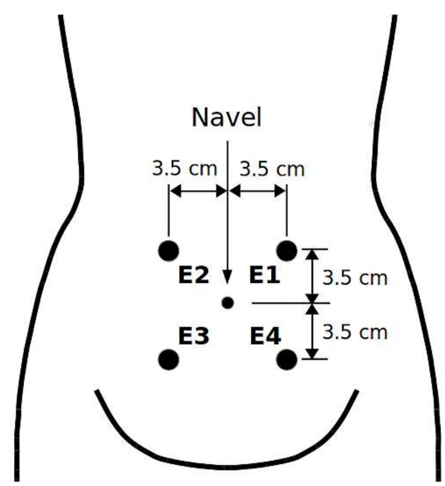


Fig. 5: The proposed prototype of the kit placed on a test subject and electrode placement positions for standard EHG recording.

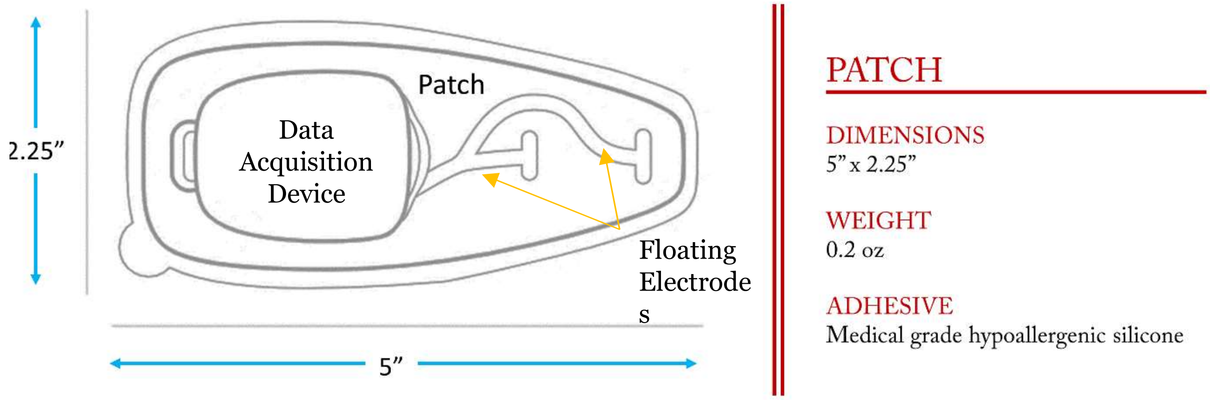


Fig. 6: The detailed design of the patch with measurements

The patch will contain the floating electrodes and the data acquisition system. Because of the use of medical grade adhesive, it will maintain proper contact with the skin surface. Considering user-friendliness, minimal dimension and weight will be ensured.

2) Data Acquisition System: We will use the Spark Fun IC AD8233, a complete EMG measurement solution available on a single Integrated Circuit (IC) package, as the data acquisition system. It consists of an instrumentation amplifier, a low pass filter, and a leads-off detection with a right leg driven circuit. Signals from the module is then fed to the input of the Analog to Digital Converter (ADC) of an Arduino Nano. The included right leg drive circuit takes in the common-mode voltage from the electrodes by negatively amplifying to drive it back to the body to reduce baseline wandering in the EMG waveform and also eliminates the 50Hz power line interference, if present. Proper lead contact and position is ensured by using floating electrodes and skin-friendly foam pad.

3) Power Management: For powering the device, two 450mAh Li-ion battery cells and a power management IC is used. For user-friendly application, the system is designed in such a way it can be charged by using a commonly available micro USB cable.

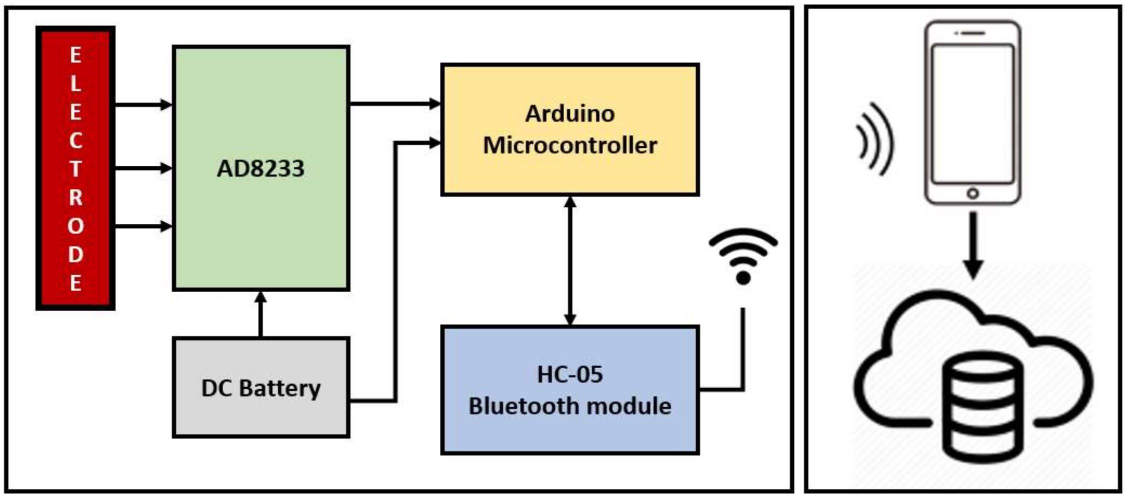


Fig. 7: The schematic diagram of the proposed uterine contraction monitoring system. The data acquisition device (AD8233) is powered up by the DC batteries and receives input from the floating electrodes. It provides output to the Arduino nano, which is connected with the Bluetooth module to transfer data to a smartphone. Term-Preterm detection and other EHG characteristics are performed in the cloud-server using deep learning algorithms while the final prediction is transmitted back to the smartphone for alerting the patient, caregiver and the physician (if enabled).

4) Data Transmission: We will utilize the HC-05 Bluetooth module for transmitting the ECG data to the smart-device. This device supports a wide range for data transmission and enables free movement of the patient, allowing distant monitoring by the physician. The final device specifications are summarized in the following Table.

TABLE : Device specification

Parameter	**Specification**
Dimension	5 inch $\times$ 2.25 inch
Electrode type	Floating electrode
Battery Type	Rechargeable Li-ion
Battery Capacity	900mAh
Wireless Transmission	Bluetooth Module - HC-05
Range	10m

B. Software Design

For designing the hardware, firstly, the electrode placement region and the wearable device dimensions are considered. Next, we have considered the data acquisition, power management, and data transmission factors.

1) Training Dataset: Our mature/premature algorithm is based on a deep CNN architecture. The Term-Preterm EHG (TPEHG) Database obtained from PhysioNet is used to train the CNN model. This dataset contains 300 uterine EMG records from 300 individual (one record per pregnant women). Among the 12 channels of data, we have selected the second channel which was digitally filtered using 3 different 4-pole digital Butterworth filters having the bandwidth 0.3 to 3 Hz. Since this band of frequency contains significant features for the detection of Term-Preterm delivery cases, this particular channel was chosen.

2) Preprocessing: At first, we cut the first and last three minutes of every single channel EHG signal as they are susceptible to the transient effect as per the instruction of the dataset provider. As the dataset is heavily imbalanced with only 10.67% of the total data belonging to the Preterm class, we have augmented the data using the linear sample shifting oversampling method as it is simple and effective technique, performing at per with the conventional techniques like SMOTE, ADASYN etc. After the augmentation, we have 1584 and 2334 number of data, respectively in the Term and Preterm class. After balancing the dataset, we map the single channel dataset to the corresponding term/preterm classes and put through the model training.

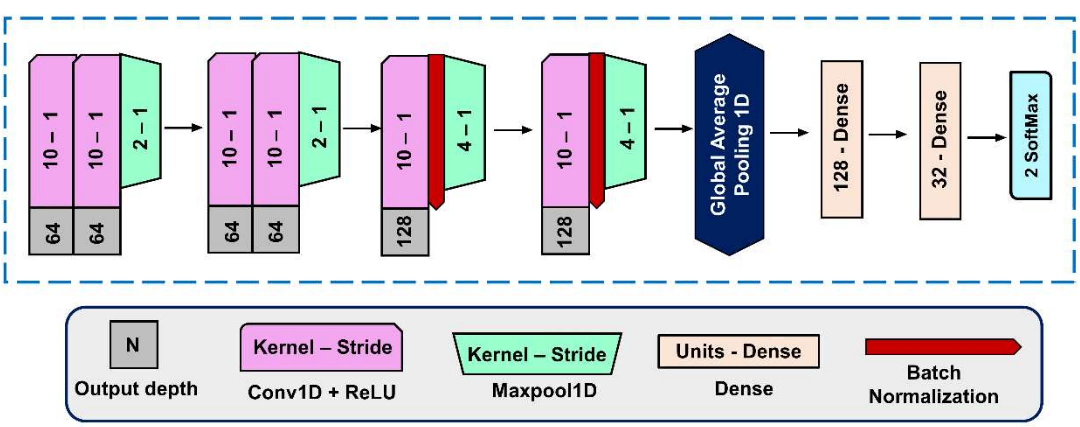


Fig. 8: The neural network architecture for the detection of uterine contraction part

3) CNN Architecture: The proposed custom 1D CNN architecture is illustrated in Fig. 3. It consists of 1D convolution, Max-pooling, Batch Normalization (a regularizer), Dropout, Global average pooling and Fully connected layers. Firstly two Convolutional 1D layers are linearly connected with a max pooling layer, then again a similar block is repeated, then this is passed to a Batch Normalization layer following a Max Polling 1D layer. The output then undergoes the Global average pooling layer and passed through a fully connected dense layer followed by a dropout layer. Finally, another dense layer with Softmax activation is employed for obtaining the final classification result. We have used Adam optimizer with learning rate 1e-4 for the training while maintaining the conventional splitting of dataset having 70%, 10% and 20% of the augmented data, respectively for training, validation and testing. We obtain a training set accuracy of about 86.87% and validation set accuracy of about 88.33%.

5) Real-time Processing: Data from the wearable contraction monitoring kit will be received in the smartphone via the Bluetooth module, which subsequently transmits the data to the server for further processing and testing. Preprocessing is performed in the same manner as the training data. Then the data is simultaneously analyzed for calculating the statistically significant information and passed to the CNN model for detecting the contraction condition. The test results are transmitted back to the display of the smartphone. If the application determines three consecutive abnormal pattern within a time frame of 30 minutes, it activates a warning alarm. The whole processing framework has been envisioned and currently is in the development phase.

5) Experimental Evaluation: The epoch-wise accuracy and loss for our model during training and validation are demonstrated in Fig. 4 and 5, respectively. On the test set, the model provides an averaged accuracy of 87.72% over the 2 classes. Experimental evaluation on any in-house data is not yet performed as we are still engaged in the development of the proposed wearable prototype for contraction monitoring.

➢ Urinalysis Kit

A urine test is used to assess bladder or kidney infections, diabetes, dehydration, and Preeclampsia by screening for high levels of sugars, proteins, ketones, and bacteria. High levels of sugars may suggest Gestational Diabetes, which may develop around the 20th week of pregnancy. Higher levels of protein may suggest a possible urinary tract infection or kidney disease. Preeclampsia may be a concern if higher levels of protein are found later in pregnancy, combined with high blood pressure.

The **Urinalysis Kit** is a home testing service that facilitates diagnosis of potential renal dysfunction during pregnancy. This can help curtail the exorbitant economic burden of complications from the frequent costly and lengthy tests at diagnostic centers. This home-based test makes it easier for pregnant women to comply with regular albuminuria, proteinuria screening, and using this will lead to earlier diagnosis and treatment of preeclampsia, reducing the maternal death risk.

A. User Interface

The urinalysis kit will include a disposable sample jar, a dipstick, the colour matching board and a dedicated app. The sample jar and dipstick can be kept at restroom with regular toiletries. The user opens the kit, fills the sample jar with urine sample, dips the stick and places it on the colour matching board. After waiting for 60 seconds (will be timed within the app), an image of the dipstick placed on the colour matching board is taken through the app. The image is normalized and data points are sent to central cloud, where they are then classified into the correct clinical result.

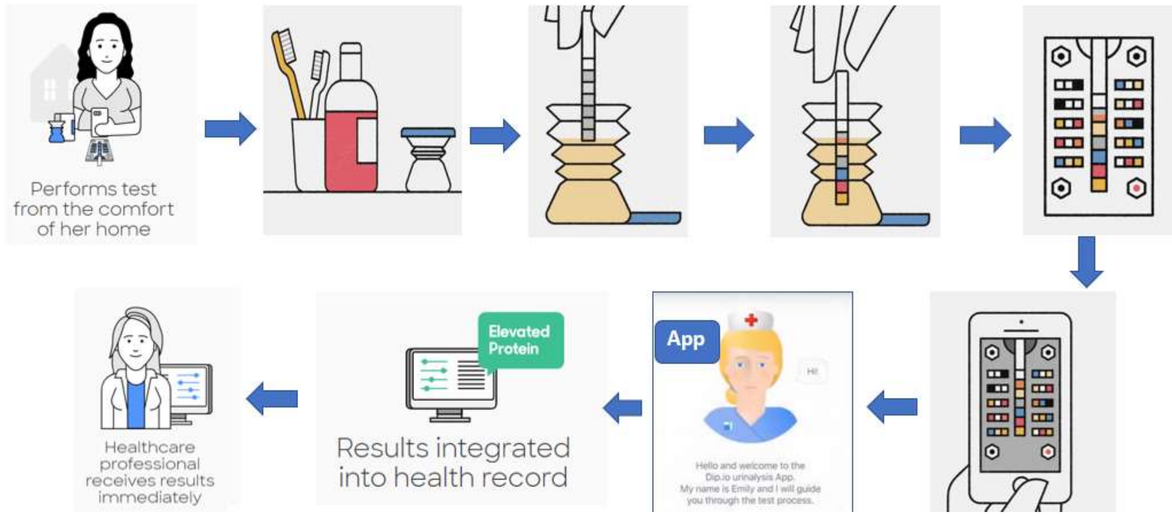


Fig. 9: An overview of how Urinalysis will work.

B. Software Functionality

At first, the images will be cropped and divided into two parts: only the strip part and the labels part. Next, we will resize the strip into fixed dimension and divide it to a dictionary of certain label detection and the label tags. This will subsequently give us the RGB value of pixel of the box. Then we will iterate over the label from right to left and match the pixel value. The index will be recorded as our flagged position indicating a regressive value of the measurement of a particular quantity. Then, we will collect all the labels value collectively and make inferences.

The parameters will be analyzed with a semi-quantitative method and include quantitative analysis of leukocytes, nitrates, glucose, ketones, protein, blood, pH, urobilinogen, bilirubin, and specific gravity. Furthermore, the kit will also provide a semi-quantitative analysis of microalbumin (10-150 mg/L), creatinine (10-300 mg/dL), and albumin-to-creatinine ratio (mg/g).

We aim to make the app well-equipped and user-friendly by providing detailed instructions as well as a "virtual nurse chatbot" to guide the patient through the steps. The app will provide test results almost immediately to both patients and their clinician through an electronic platform. However, due to the unavailability of such data, the software part of the urinalysis kit could not be implemented.

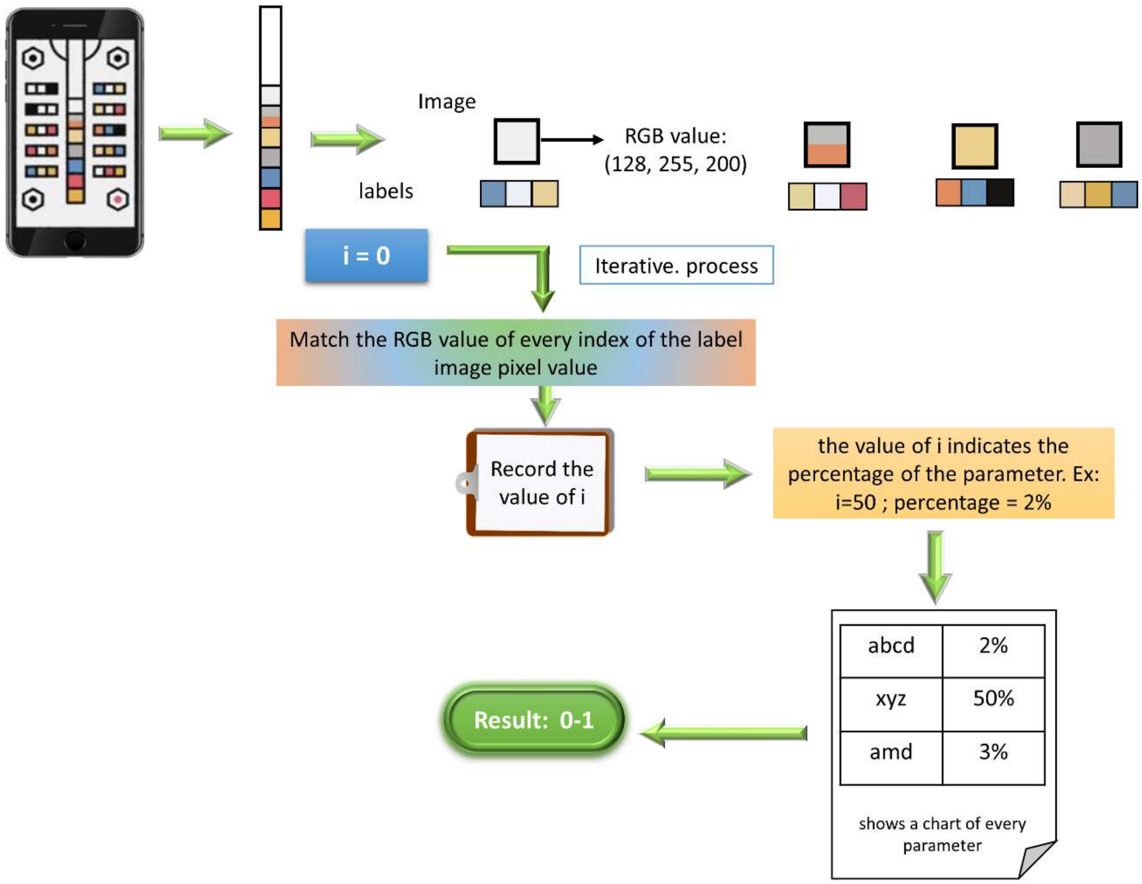
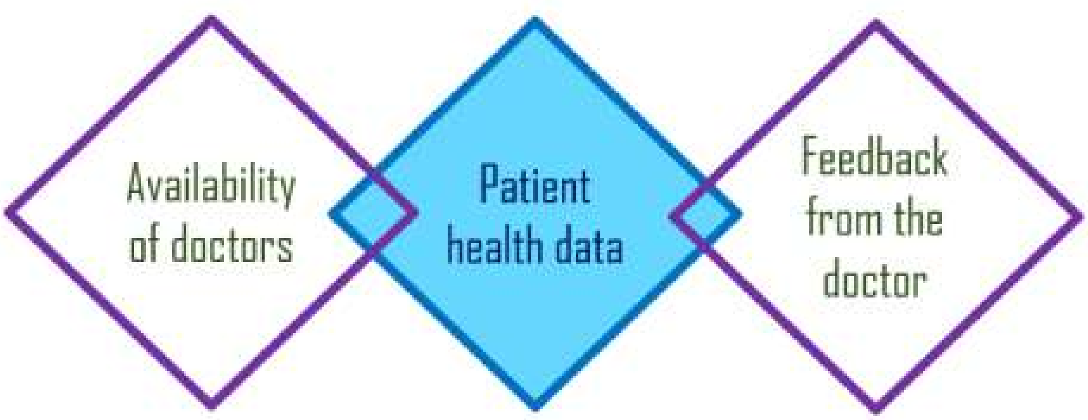


Fig. 10: Pathway of software analysis with OpenCV for the Urinalysis

➢ Smartphone Application

We will design a mobile application. This app will be a platform to connect the all two devices and a medium of communication between the patient and doctor. It is one kind of both health and telemedicine app. Here the user will be able to record and view the contraction intensity-tie graph, monthly and daily blood pressure chart and the result of urinalysis. Whenever patient wishes to take appointment, she can send the data to the available or her preference doctors, and doctors will be able to read the data history and suggest medicine and others to the patients.



➢ Steps of Using the Mobile App

1. At first patients will sign up into the app. Those who have previous account can log in into this app. This app is only for pregnant women users.

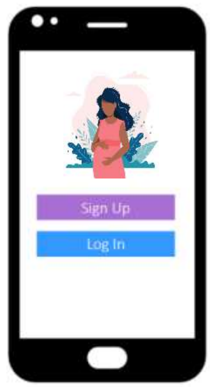


Fig. 11: Log in and sign up option.

2. If one enters into the app, the patient will have to fill up the patient profile. In the patient profile, the patient will give info about her name, age, weight, height, current week etc.

Fig. 12: Options for filling up patient info; name, age, weight, height and week of pregnancy

❖ Steps of Using the Mobile App

3. After filling up the patient profile, patient can see her current data of her week. She can also be able to see the previous recorded data in hourly, daily, weekly and monthly basis. Three different categories can be seen- contraction monitoring data, blood pressure data and urinalysis test results.

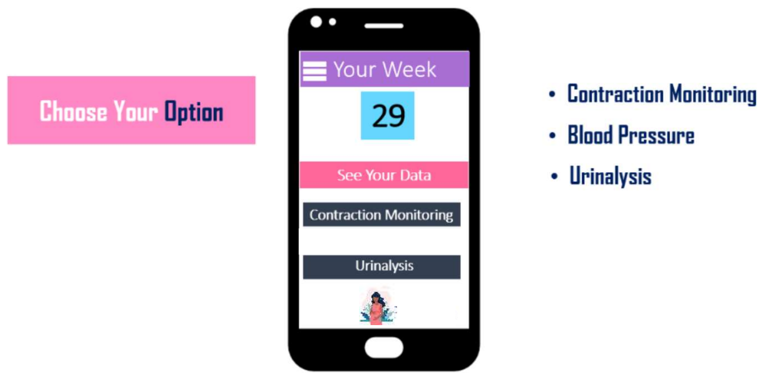


Fig. 13: Options for seeing data in 2 different categories- contraction monitoring data and urinalysis test results.

4. By choosing option of "Contraction Monitoring" patient will be able to see the previous recorded data. After connecting the contraction monitoring kit with smartphone via Bluetooth, the data of contraction monitoring kit will be synced and saved on mobile from contraction kit, and able to be viewed from app.

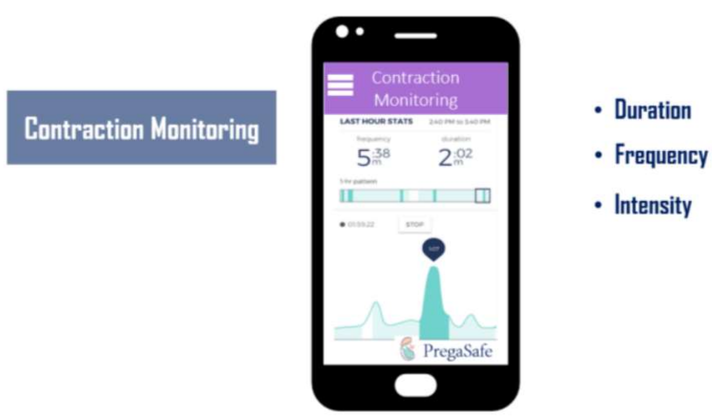


Fig. 14: Contraction tracking data with real time.

➢ Steps of Using the Mobile App

5. By choosing option of "Urinalysis", patient will scan an image of the dipstick placed in the slot of the color matching board. By rigorous image processing, the scanned image will be automatically color corrected as per the picture quality and then using clinical decision support algorithms of machine learning, the contents of urine will be determined quantitatively and store the data in the central server.

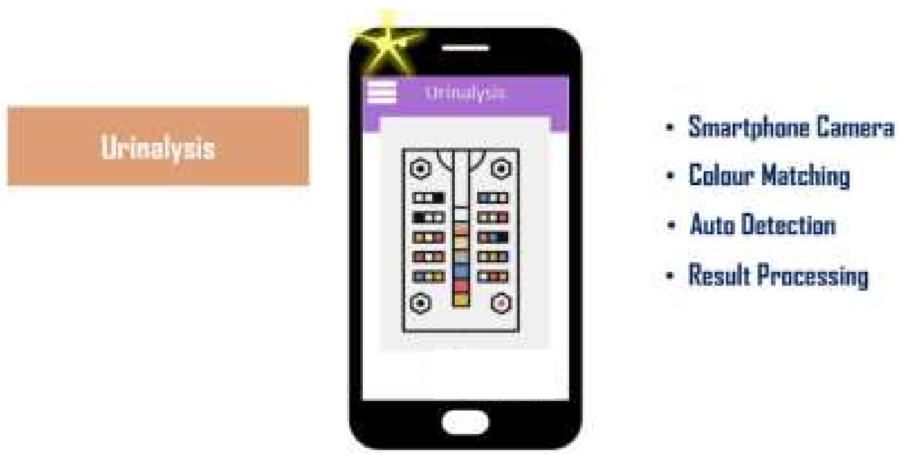


Fig. 15: Image Processing of Colour matching board.

6. . Whenever smartphone will get the internet connection, it will sync and update the data to the server. This data will be kept securely by dedicatedly reserving the privacy of patients.

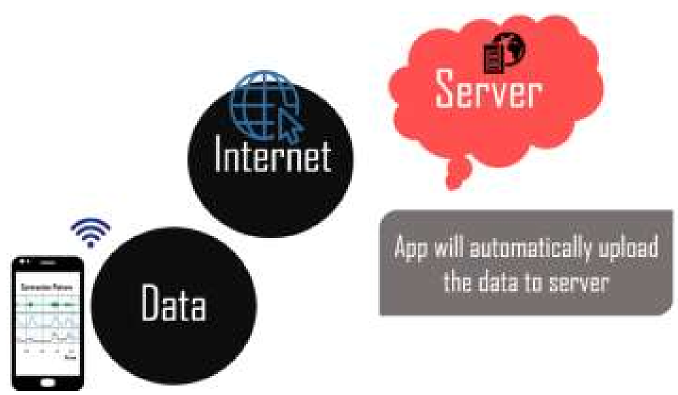


Fig. 16: App interfacing with online server.

❖ Steps of Using the Mobile App

8. The processed data will be transferred to doctor whenever patient wants. Patient will be able to select a doctor. In this app, there will be single profile available for the doctors. When the doctor will log into the app and will be online, then a green button will light up beside the doctor profile. There will be categories for different doctors according to their field of specialization so that patient can find their desired doctor easily. After selecting the doctor, they will be able to communicate with the doctor easily.

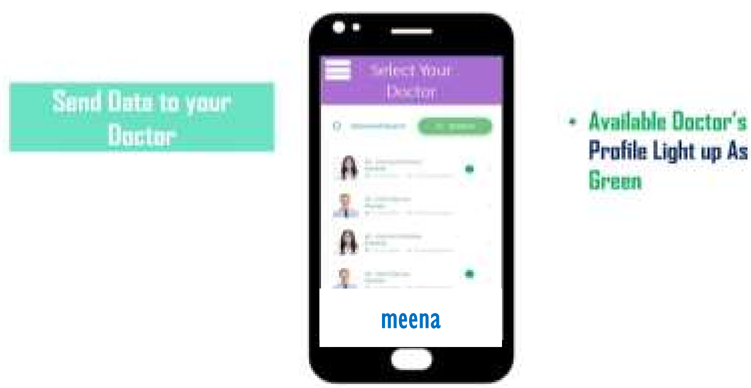


Fig. 17: Sending data to doctor and connecting for appointment

Then doctor will observe all the data and report and will analyse the patient health. Patient health condition will be observed by the doctor. The doctor will then prescribe a medicine or provide some suggestions. If the condition is severe then the doctor will suggest some treatment information. The doctor will be able to

Receive the processed data of urinalysis, blood pressure, heart rate and uterine contraction

- Receive the heath information and previous health reports of the patient from the app
- Receive the processed data of urinalysis, blood pressure, heart rate and uterine contraction
- Can also view the daily, weekly and monthly chart to take decision better
- Will analyse the data provided from the server

➢ Additional Features of the Mobile App

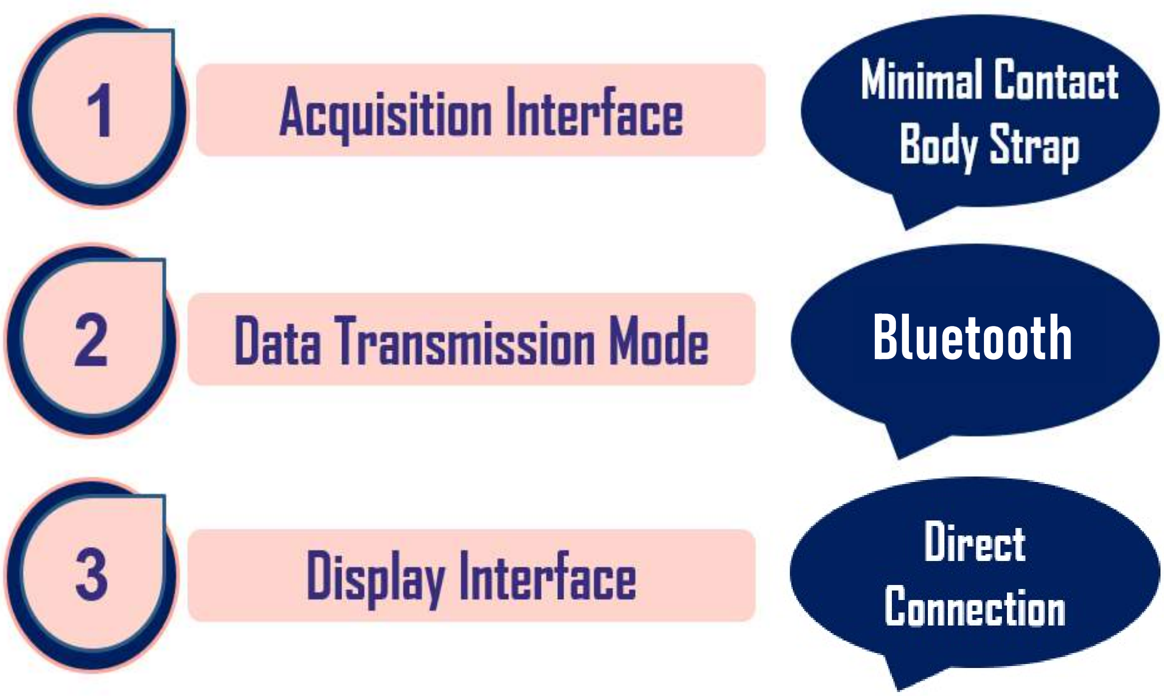
- Will provide suggestion to the patient and prescribe medicine for heath purpose
- Accept video call from the patient if necessary

If the patient want to do video conferencing then she can select the option and do this work by connecting face to face with the doctor. By using this app, the patient will be able to minimize cost using only the text massage form the doctor containing all the suggestions. On the other hand, he/ she can do video conferencing with the doctor easily as the cost is not too high.

Feasibility

The proposed device is a mobile application-based prenatal health monitoring unit. It provides a low-cost remote monitoring medical service for pregnant women by screening and diagnosing uterine contraction pattern and urinalysis reports. It targets the pregnant women, a special group of patients who needs very frequent monitoring for the wellness of both mother and fetus.

This remote telemedicine system will provide at-home service with reliability by eliminating the requirement of frequently visiting diagnostic centers for urinalysis tests, blood pressure, heart rate and specially, contraction monitoring. For rural or poor people whoever will have any crisis of internet or finance they can take this service from nearest booths. This app will create a bond between rich, middle or poor country patients and efficient doctors and will increase the healthcare facilities.



Digital signal processing, automatic detection and other low-cost materials in kits will make the devices more obtainable. Interfacing the devices with mobile will make the system easier for both urban and rural people and health workers. By adding a suitable and user-friendly interface/app system on mobile will surely help doctor to diagnosis and detect any abnormalities or disease of patient even from far distance.

The app will process the signals from patients and will represent it to doctor to identify disease within a short time. Doctor can see the output data from server or contact with patients and can suggest medicines, precautions or tests for further treatment. If the whole process can connect all class people, it will create a large telemedicine communication and remote monitoring system in Bangladesh and may take a tremendous effect on providing cheap and good healthcare system as well as reducing the load of patients on hospitals and health-care centers.

Scalability & Sustainability

AVAILABLE COMPONENT USED IN DEVICE DESIGNING

LOW COST SYSTEM

DEPENDENCE ON LESS CLOUD MEMORY

PROPOSING RENTAL SERVICE

HAVE LONG TERM USAGE

CAN BE USED BY MULTIPLE WOMEN FOR MULTIPLE PREGNANCY PERIOD

Scalability & Sustainability

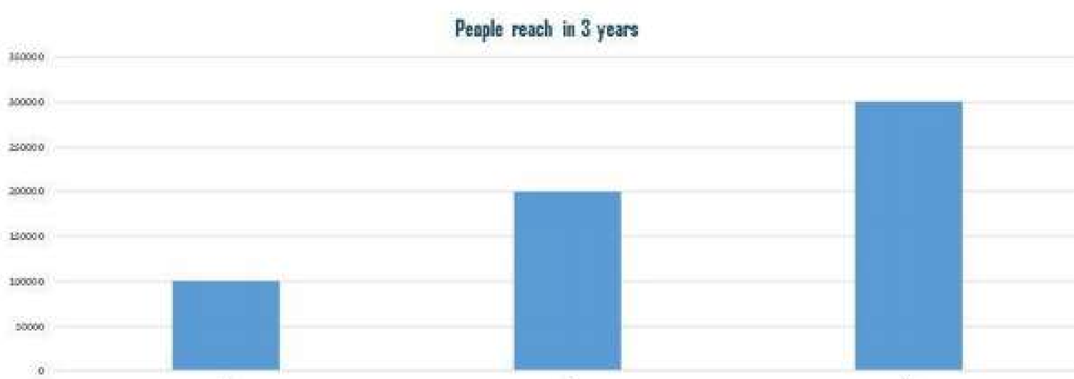
We have some fixed and some variable cost for providing the service including the development and maintenance cost of 30,000-50,000 BDT approximately.

Table : Cost Analysis

Name of component	Price in USD(Per Unit)
Urine DipStick	0.4
Contraction Detection	15
Connecting wire and accessories	5
Total	20

In this case, the cost of DipStick is variable as a user needs a new DipStick each time she tests. And for other instrument there is a pay per use cost. Hence the total cost for one test is around 80 BDT per test. And we have planned to make a profit of 20 BDT per test. So the gross total of our service is 100 BDT per test.

And we have decided to run our pilot project on at least 1000 clients. So the total money involved is 1,00,000 BDT per month. Hence, we can come up with 6,00,000 BDT over first six months.

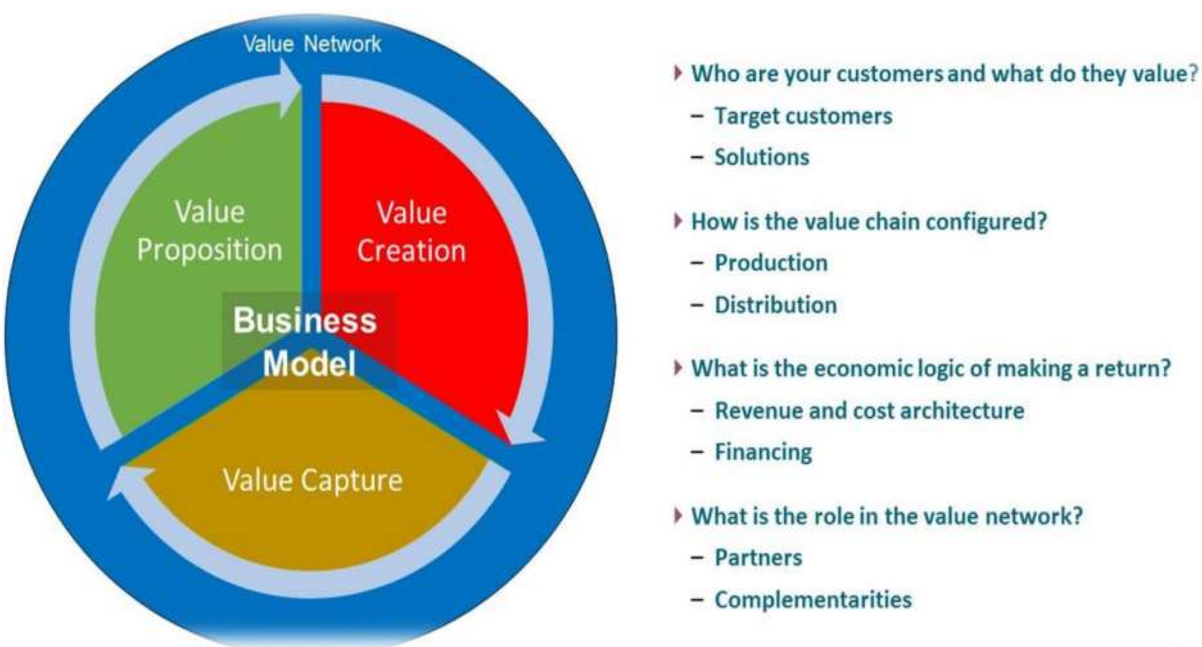


Scalability & Sustainability

We should follow a strong business model to reach the maximum of our profit. For this we have to set some checkpoints which will indicate the overall aspects of our business like:

Target Customers: As we said earlier, our target customers are the UHC and the individuals. So we have the chance to make profit both from corporate and individual level which increases the total profit at large.

Value chain: A value chain is a business model that describes the full range of activities needed to create a product or service. For companies that produce goods, a value chain comprises the steps that involve bringing a product from conception to distribution, and everything in between—such as procuring raw materials, manufacturing functions, and marketing activities. For us the value chain may look something like this:



Scalability & Sustainability

1. Primary category:

Inbound logistics: Functions like receiving, warehousing, and managing inventory.

Operations: Procedures for converting raw materials into finished product.

Outbound logistics: Activities to distribute a final product to a consumer.

Marketing and sales: Strategies to enhance visibility and target appropriate customers—such as advertising, promotion, and pricing.

Service: Programs to maintain products and enhance consumer experience—customer service, maintenance, repair, refund, and exchange.

2. Secondary category:

Procurement: How a company obtains raw materials.

Technological development: Used at a firm's research and development (R&D) stage—designing and developing manufacturing techniques; and automating processes.

Human resources (HR) management: Hiring and retaining employees who will fulfill business strategy; and help design, market, and sell the product.

Infrastructure: Company systems; and composition of its management team—planning, accounting, finance, and quality control.

Profit Policy: We have planned that initially we will run our project as a pilot one. And if it works well, we may think for the large-scale production.

Role in value network: As we have mentioned earlier, we will play the role of intellectual property holder and prototype production.

Scalability & Sustainability

Why will customers be compelled to use the product?

One big question for any company is that why will customers be compelled to use the product. In this case our answer is, our product has three major parts- measuring contraction, urinalysis and blood pressure measurement. These services are available somewhat, but not in an integrated way.

So, customers will use our product to

1. have a more integrated platform to have all the essential test done
2. Maintain test results without hassle
3. Get the close supervision of doctors easily

How will the product reach customers?

Our product may reach the customers in two ways;

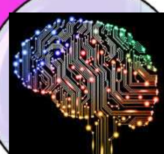
1. Thorough UHC: The UHC associated will recommend our product as it is worth recommending.

2. The root level marketing: We may need to run promotion campaign and advertisement including the beneficiaries to reach the individual level clients.

Originality & Innovation

- Trained in Physionet
- Simple Neural Network
- Inference time less

IMPLEMENTATION OF DEEP LEARNING



- Using simple image processing
- Inference speed fast

IMPLEMENTATION OF OPENCV

- Easily accessible by the user
- Results presented through images for the less educated

USER FRIENDLY INTERFACE

Parameters are

- Urinalysis
- Uterine Contraction

DIAGNOSIS ON MULTIPLE PARAMETERS

For training the Neural network in Uterine Contraction, we train the model with the Physionet Dataset. But the samples are only 300 and 12 channels, so we have used augmentations –

- Oversampling by Linear Sample Shifting (shown in code)
- Oversampling by Circular Sample Shifting
- GAN (Generative adversial network)
- VAE (Variational Auto Encoder)

Thus, we have ensured that in spite of having a simple structure, our network is properly trained and capable of handling the varieties of cases.

Future Directions

We have taken the signals of Physionet data, which had a very small amount, so we augmented the dataset, we have shown in code the linear oversampling method, we will also apply the circular oversampling methods, VAE method, GAN method in future and train the device with data with all sort of exceptions as possible to make the device capable giving all sort of generalized predictions. For the Urine analysis part we did not use any sort of neural network remaining the fact to lessen the computational cost and improving the efficiency for real time prediction.

In a country like Bangladesh, the challenge is threefold, the reach of the device to every people, its pricing and the awareness of people of maternity health issue. We are proving a solution to all the problems by designing a device by designing it with available electronics parts in our country, which makes it reachable to the people who cannot effort hospital costs. The device is not needed all the time throughout the pregnancy, so we are proposing rental method for the device such that it is reachable to everybody. Also we synchronize the cloud part. By the help of IOT we made it more feasible so that the user does not have to worry about a different output device to see the results. The user interface is so simply designed that anybody would know the results and be cautious of the fact of maternity health risks, thus we will be able to spread awareness regarding this issue