Medicle

Healthcare Everywhere

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The Problem

As of 2022, the Indian Rural population is 898 million, constituting approximately 65% of the Indian population. There is a total of 69,264 hospitals in India. While that certainly is an elephantine figure, roughly 75% of the healthcare infrastructure in India is concentrated in urban areas where there is only 35% of the population. The remaining 65% have direct access to merely 25% of national healthcare infrastructure. Rural healthcare in India is characterized by under-staffed facilities with bad infrastructure and low availability of medicines. According to a KMPG report, “74% of Indian doctors are catering to the needs of the urban population.”

Healthcare is the right of every individual but an absence of quality infrastructure, scarcity of qualified medical functionaries, and most importantly lack of access to basic medicine and medical facilities thwart its reach to the majority of the Indian population.

Dr. Anup Sadhu, a radiologist, “The situation of rural health care in India has not changed much during the past decade, though it is difficult to gauge it from outside. The patients are still in the hands of quacks and unscientific medical practices. The villagers have to travel long distances to the nearest hospital in case of emergencies and their only viable transportation is private transport which many cannot afford.”

Primary Health Centers (PHCs) in India are also generally unequipped to handle the high demand of healthcare. Reports find that over 60% of PHCs in India only have one doctor, while

5% have none, according to the Economic Survey 2018-2019, tabled in the Parliament on July 4, 2019. This issue is all the more severe in rural India due to the immense disproportion of medical facilities to the populace.

The sheer magnitude of the crisis becomes increasingly dire when you consider that rural medical practitioners (RMPs), who provide 80% of outpatient care, have no formal qualifications for it. They sometimes lack even a high school diploma.

The average medical expenditure per hospitalization in a government hospital is Rs 4,452. Given this, the poor are less likely to avail of hospitalization. Families in the poorest 20% of the population make up the fewest cases of hospitalization which is because of an inability to fund medical expenses because of low household income.

Due to non-accessibility to public health care and low quality of health care services, a majority of people in India turn to the local private health sector as their first choice of care. If we look at the health landscape of India 92 percent of health care visits are to private providers of which 70 percent is urban population. However, private health care is expensive, often unregulated, and variable in quality. Besides being unreliable for the illiterate, it is also unaffordable for low-income rural folks.

Lack of basic medical facilities and poor sanitation conditions in the government hospitals across a few states have added to the adversities of ailing patients, as per an operation conducted in these hospitals by ANI. In some hospitals, patients are forced to

sleep on wet floors due to water leakage from washrooms, and authorities do not even keep a check on them, while in others, poor facilities and unhygienic conditions with piles of garbage and filth are seen inside the premises. Patients sit on the ward floors due to broken beds and stretchers. Attendants spit all around the hospital premises, creating an unhealthy environment for the suffering patients. All this in turn leads to the spread of more and more diseases and endemics.

To control the spread of diseases and reduce the growing rates of mortality due to the lack of adequate health facilities, special attention needs to be given to health care in rural areas. The key challenges in the rural healthcare sector are low quality of healthcare, poor efficacy and efficiency, lack of affordability, and limited access to facilities.

Rural healthcare in India faces a crisis unmatched by any other sector of the economy.

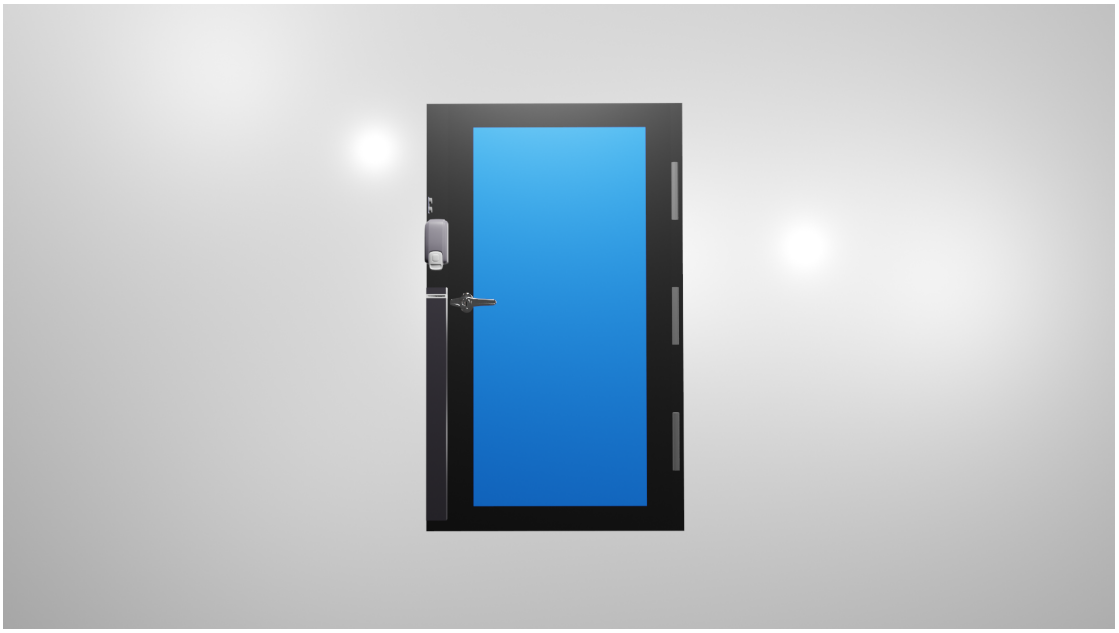
Solution

The solution to this vast injustice lies in utilizing scalable, effective, and efficient technology. TechBattalion presents this solution in the form of Medicle, a medical cubicle designed to bridge the gap between qualified medical professionals and rural citizens.

As highlighted before, the key challenges in the rural healthcare sector are -

- Low quality of healthcare
- Limited Access to Healthcare
- Lack of Affordability
- Poor efficacy and efficiency

Medicle successfully tackles each of these challenges and will play a considerable role in overcoming the crisis of rural healthcare in India.



Project Summary

Medicle, a play on words, is a culmination of the words **Med**ical and Cub**icle** because that is precisely what it is, a Medical Cubicle. Every and any diagnosis requires a few vitals to be tested. These essential metrics are -

- Height
- Weight
- Body Mass Index
- Temperature
- Blood Pressure
- Oxygen Saturation / SPO2

- Heart Rate

Medicle constitutes a cubicle with an array of sensors that will conduct all these indispensable tests automatically. The crucial data collected will then be transferred over the web to a firebase hosted server, wherein the doctor can access the information from anywhere with an internet connection.

The doctor then, armed with both the vital details of a patient and a face-to-face discussion over a zoom call, will make his judgment and deliver his diagnosis. The doctor may suggest a medication to be administered, might identify a solution to the problem the patient faces or might clear any concerns the patient might have. The doctor might also recommend that the patient travel to a hospital for more detailed tests and further examination if deemed necessary.

Medicle, therefore, saves the patient both time, expenditure, and effort in getting a diagnosis, only having the patient travel to a hospital if absolutely necessary. The patient also rapidly gets a diagnosis as the doctor receives the vital data promptly through automated tests.

Challenges Overcome

Low Quality of Healthcare - As described in our problem statement, rural medical practitioners (RMPs), who provide 80% of outpatient care, have no formal qualifications for it and sometimes lack even a high school diploma. Reports find that over 60% of PHCs in India only have one doctor, while 5% have

none. Being egregiously understaffed and unqualified, rural Indians hold a very low standard of quality for healthcare.

Since Medicle would be connected to a host of government-officiated doctors, the quality of healthcare would be substantially higher and would remain at an adequate standard.

Limited Access to Healthcare - Another major issue in rural healthcare was access, as merely 25% of healthcare infrastructure is accessible to rural citizens. As a result of this disproportion, rural citizens were forced to travel long distances to access healthcare services in urban areas, increasing not only their expenditure but also their time and effort investment.

Medicle is a scalable technology that can be placed nearly anywhere, with its only requirements being access to electricity and an internet connection. Since patients will be able to get a reliable diagnosis at a Medicle stationed in their rural vicinity, the need to travel to urban areas for the same is abolished.

Lack of Affordability - Rural Indians are unable to afford private healthcare and the expenditure of traveling to an urban area to access public healthcare is a considerable burden on their relatively lesser income.

Since Medicle gives a reliable and effective diagnosis at a cost of only ₹35, it enables rural citizens to make the least expenditure possible.

Poor efficacy and efficiency - Travelling all the way to an Urban area to access healthcare require a significant time investment. Since most public healthcare centers are also severely understaffed, the patients often to have wait for long periods of time in subpar conditions.

Since Medicle provides an effective diagnosis in an incredibly efficient manner due to the automation of all vital tests, Patients will have a drastically reduced time investment.

Technologies Used

The following components and technologies have been integrated into Medicle -

Part	Purpose
Arduino Mega	Controller
HC SR04 Ultrasonic sensor	Height
HX711 IC	Weight
300Kg Load Cell	
MAX30102 Blood Oxygen and Temperature Sensor	Oxygen Saturation and Temperature
SUNROM 1427 Blood Pressure Sensor	Heart Rate and Blood Pressure
Monitor	Visual Interface

WebCam	Camera and Microphone
Buzzer	Auditory Interface

All of these components are controlled by the **Arduino Mega** and will be transferred to a **locally hosted GUI** for the doctors to access and diagnose. Doctors will be on a **live zoom call** held on the **Raspberry Pi** to interact and diagnose the patients while guiding them through the process.

Advantages

Accessibility

Since Medicle is a scalable technology it can be placed anywhere with electricity and access to the internet. This

enables Medicle to be a highly versatile technology that can be set up in essentially every village in India to be accessed by the majority of the population. Providing the ease of simply walking to the nearest Medicle, the gap between rural Indians and quality medical professionals is bridged through the approachability and accessibility that Medicle provides.

Cost Effectiveness

Since through Medicle, an effective diagnostic checkup is carried out in ₹35, it broadens the reach of medical facilities in India by catering to the relatively poorer rural Indians. It enables them to access quality healthcare at an affordable price and removes the need for expenditure borne in traveling long distances.

Efficiency

Since Medicle runs a series of automated tests through high-quality and precise equipment, the data from which is instantaneously provided to the medical professional, as is the prescription generated and sent to the patient. This removes the long waits in subpar circumstances as automation leads to higher efficiencies.

Quality of Services

As emphasized before India's medical infrastructure, specifically in rural areas, are heavily understaffed, underequipped, and underdeveloped. Since Medicle will connect patients to an array of government officiated medical professionals, the quality of service will be guaranteed.

Efficacy

Since the standard of healthcare in rural India can often be quite low, the accurate data collected by the sensors coupled with the reliable diagnosis conducted by the doctor ensures a more effective healthcare experience for users.

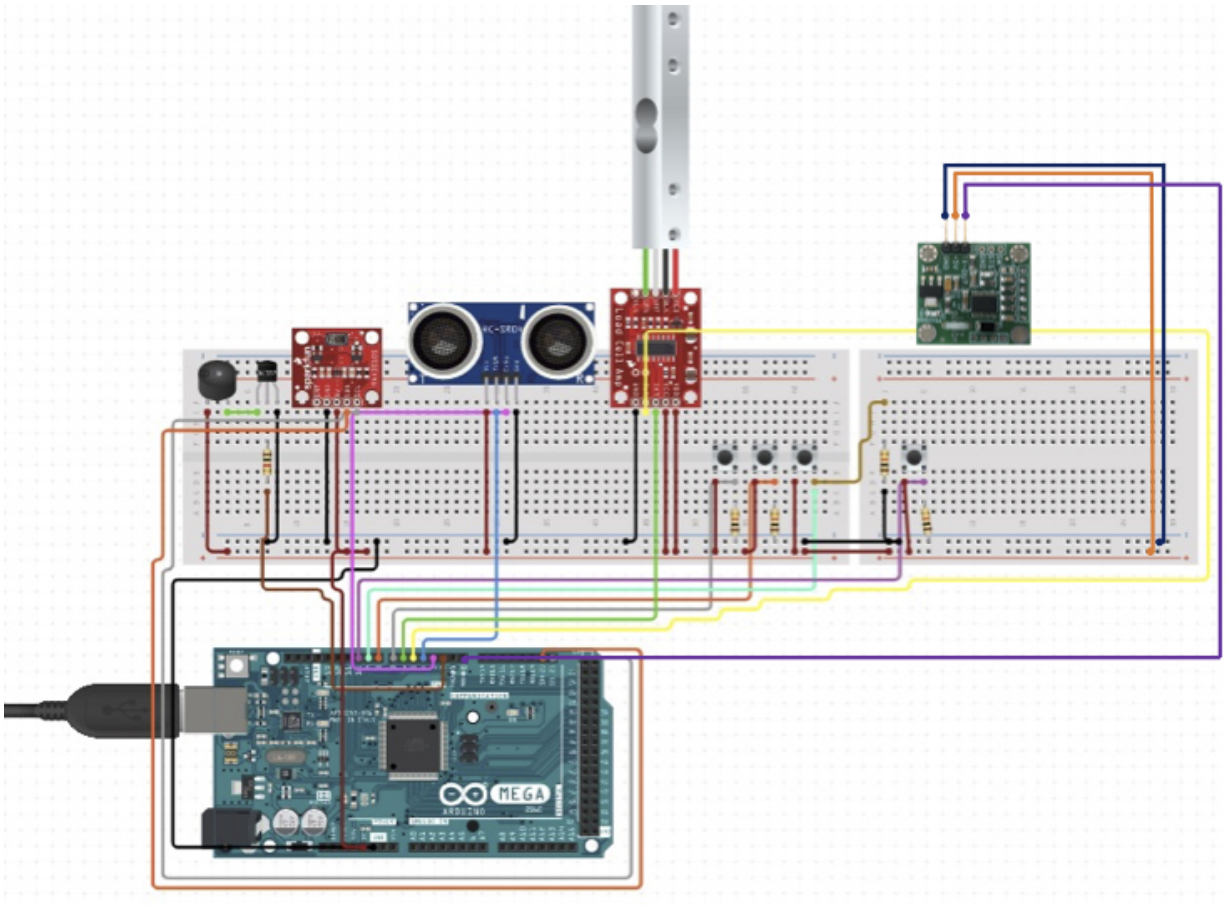
Increasing Marginal Utility

Since Medicle is a scalable technology and the market for the same is quite vast, with each additional implementation of medicle in villages - more and more citizens will get access to quality healthcare and an increasing amount of data will be collected. This gives Medicle increasing marginal utility for the government and incentivizes heavy use of the product.

Hygiene

Since Medicle is physically small and only permits one user at a time, similar to an ATM, maintenance of hygiene and sanitation will be far easier than for a hospital. The installation of garbage bins and regular sanitization of the cubicle will ensure the standard of hygiene is met.

Circuit Diagram



Code

Medicle runs on the Arduino Mega and is coded in C++. The 313 lines of code ensure that the sensor automation is accurate, rapid, and precise. Our own algorithm takes hundreds of values over a short period of time and averages them out to compute highly accurate data.

We've used 4 libraries in the program -

- HX711
- Wire
- MAX30105

- spo2_algorithm

The program composition includes functions for each component which are accessed through character inputs from the Serial Monitor. The doctor will remotely control these character inputs and guide the patient through the automated tests. Once the data is received the doctor will access the GUI that we built using the python library **PyQt5**. Through this, the doctor types out his prescription/recommendation and prints it out remotely for the patient to take with them. All code can be viewed on our Github Repository.

github.com/theGeekyBoi/Medicle

Setup code for program

```
void loop() {
  while(Serial.available() > 0)
  {
      chinp = char(Serial.read());
      break;
  }
  if(chinp == 'h')
  {
    //Serial.println("Measuring height....");
    float h = checkheight();
    //Serial.println("Measuring weight....");
    int w = checkweight();
    Serial.print("Height= ");
    Serial.print(h);
    Serial.println(" cm");
    Serial.print("Weight= ");
    Serial.print(w);
    Serial.println(" Kg");
    bmih = (h/100);
    bmi = w/(bmih*bmih);
    Serial.print("BMI= ");
    Serial.println(bmi);

  }
  else if(chinp == 's')
  {
    //Serial.println("Measuring spo2 and temperature....");
    sp2temp();
  }
  else if(chinp == 'b')
  {
    //Serial.println("Measuring blood pressure....");
    while(pres)
    {
    bp();
    }
    pres = true;
  }
  delay(1000);
  chinp = 'n';
}
```

void loop with function call and character input

Business Model and Financial Plan

Component	Cost	Quantity	Total Cost
Arduino Mega	₹850	1	₹850
300Kg Load Cell	₹800	1	₹800
HX711 IC	₹150	1	₹150
HCSR04	₹120	1	₹120

MAX30102	₹300	1	₹300
SUNROM 1427 Blood Pressure Sensor	₹3,000	1	₹3,000
Monitor	₹5,000	1	₹5,000
Webcam	₹1,000	1	₹1,000
Raspberry Pi	₹3,813	1	₹3,813
Wires	₹1	160	₹160
PCB	₹100	1	₹100
Printer	₹700	1	₹700
Structural Material	₹15,000	1	₹15,000
Production Price	₹30,993		

The given prices are all in reference to purchasing one quantity of the commodity, however, when the same are bought in bulk for mass production of Medicle, prices are expected to fall by a minimum of 25% resulting in -

Expected Production Price - ₹23,244
Proposed Selling Price -> ₹27,000
Profit -> ₹3,756
Profit Margin -> 16.159%

Medicle will be placed in areas with high population density but no healthcare services.

The initial cost will be high, but rural officials will rapidly earn back their initial investment through income from the unit. Users will be charged ₹35 per checkup and we will receive a 14.2% cut, i.e. ₹5 per transaction. Therefore, Medicle will also produce revenue in perpetuity.

All revenue will be divided between us and the rural officials. After the point of satiety for the government, they will be encouraged to reinvest in other healthcare benefits and maintenance. The rural officials will be making ₹30 per check-up. This means they will make back their initial investment after 900 check-ups. All further transactions will result in profit. Medicle will be connected to government-officiated doctors and will prove to be a fruitful investment for not only rural citizens but the entire population of India.

Future Scope

In future iterations of Medicle we intend to integrate the NodeMCU ESP8266 to extrapolate all sensor data from Medicle and upload and organize all of it on firebase hosted SQL server for prescriptions, vitals, and other data to be stored digitally for medical professionals to refer to. We also plan to look into incorporating blood tests as they are the future of medical diagnosis.

The ultimate goal for Medicle is to have at least one Medicle in every rural vicinity in India, ensuring 898 million people get access to the standard of medical healthcare they deserve.

Impact

Health is the most important aspect of anyone's life. Without health, all other metrics lose meaning. Medicle ensures that 898 million people get access to quality healthcare. It overcomes all the key challenges that the rural medical industry face and provides an effective, efficient, reliable, inexpensive, and accessible solution to all rural citizens. It bridges the gap between rural Indians and certified medical facilities and serves the purpose of ensuring that their healthcare needs are met.
The medical industry in rural India is an untapped market and one that requires significant strides to be made, and Medicle is most certainly one such stride. The far-reaching vision of Medicle will impact the entire population of India by catering to rural healthcare needs.

Medicle could be the difference between a life saved to a life lost.

Business Model Canvas

Key Partners

Central Government
- Authorize setup of Medicle Installments
- Purchase Medicle Units
- Connect Medicle to a database of officiated medical professionals for quality healthcare
- Take forward and utilize Medicle's scalability and positive marginal utility to have an impact on the maximum amount of people

Rural Government
- Setup and Maintain Medicle Units
- Educate rural citizens on utility of Medicle stations

Key Activities

Automated sensors conduct the following vital tests -
- Height
- Weight
- BMI
- Pulse
- Blood Pressure
- SpO2
- Temperature

Key Resources

- Database of government officiated medical proffesionals
- Internet and electric connection to power the unit
- General maintenance of Medicle unit

Value Propositions

- Access to reliable Healthcare
- Higher relative standard of quality
- Efficient and reliable diagnostic
- Cost-effective solution to the pressing crisis
- Highly convenient for rural citziens
- Effective healthcare experience for users
- Reliable and assured medical assistance
- Increased approachability for medical healthcare
- Increasing marginal utility for the government
- Large positive societal impact

Customer Relationships

Zero cost customer relationship, the customer only has a connection with their designated doctor and leaves with a Medicle officiated prescription slip.

Channels

- Database of government officiated medical proffesionals
- Internet and electric connection to power the unit
- General maintenance of Medicle unit

Customer Segments

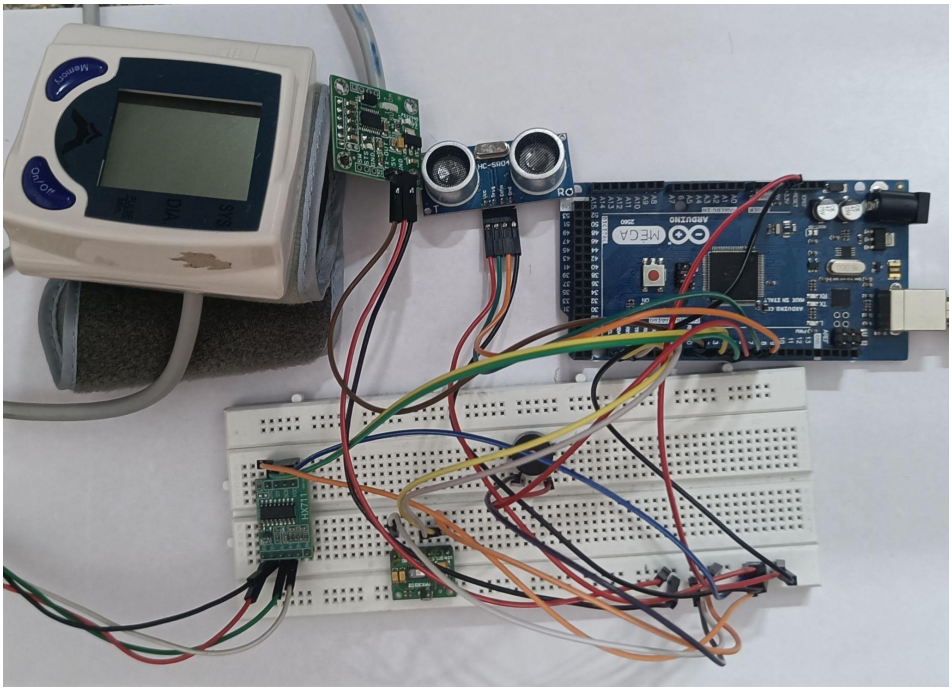
- Our target consumers are the 898 million rural citizens in India who lack access to a certain quality of medical healthcare and are unable to take care of the essential aspect of living
- It is a mass market that is currently untapped as no product like Medicle exists in Rural India
- It is an undiversified and unsegmented market as we are only appealing to one demand of the common consumer

Cost Structure

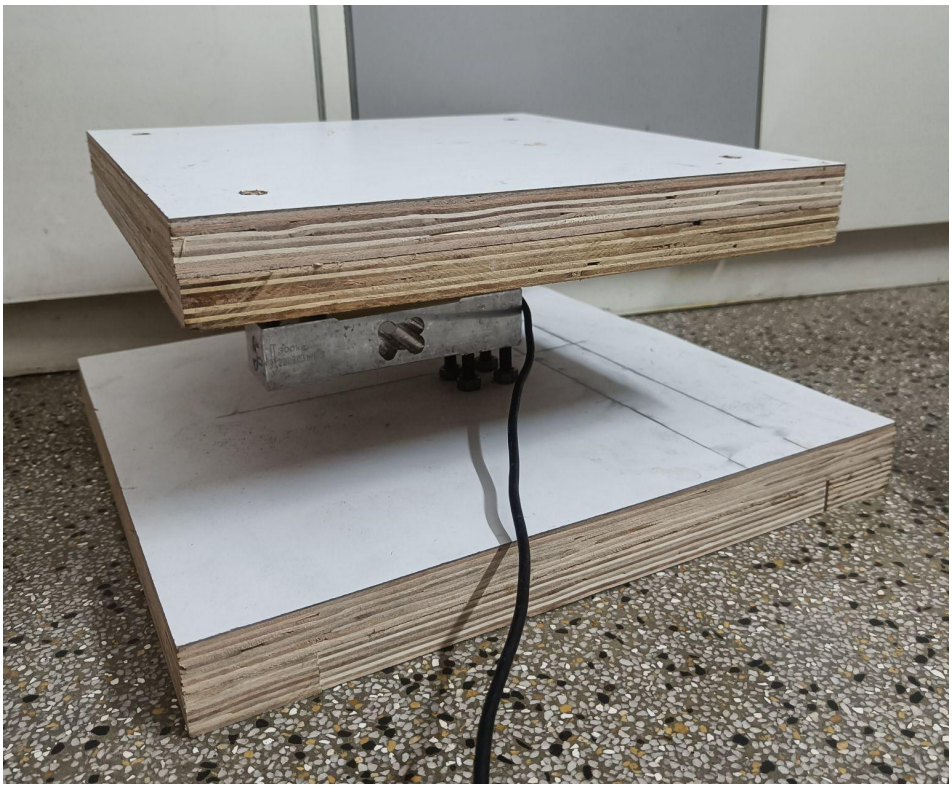
Costs are present in the form of resources required to build a Medicle Unit. These costs include various sensors, controllers, interfaces, and building materials for the physical body of the stall. Other costs, which fall on the consumer and not us, include maintenance of sanitation and hygiene along with general care of the Medicle Unit
- Total Production Cost - ₹30,993
- Estimated Production Cost after components are purchased in bulk - ₹23,244

Revenue Streams

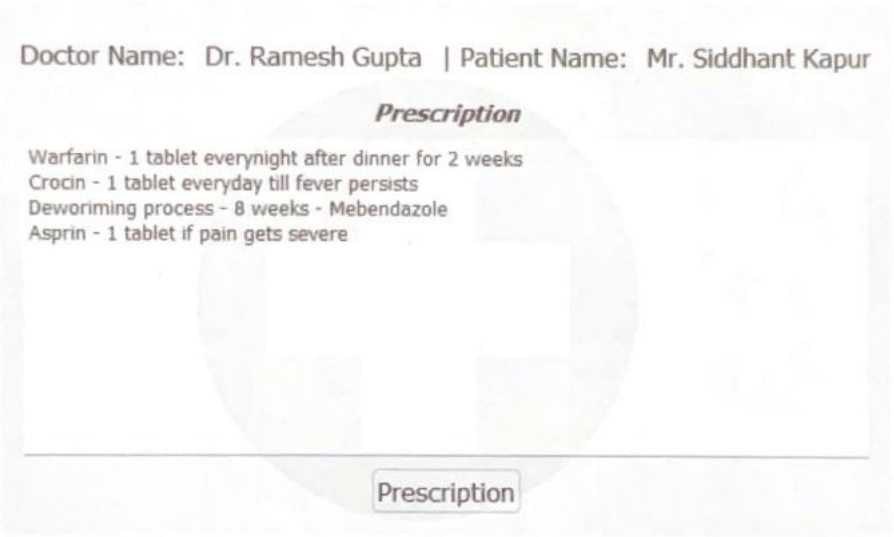
Revenue will be generated through 2 methods
- The initial sale of the Medicle unit at a markup and profit margin of 16.159% for a profit of ₹3,756
- Income in perpetuity at a commission rate of 14.2% which nets ₹5 per checkup per user of each Medicle



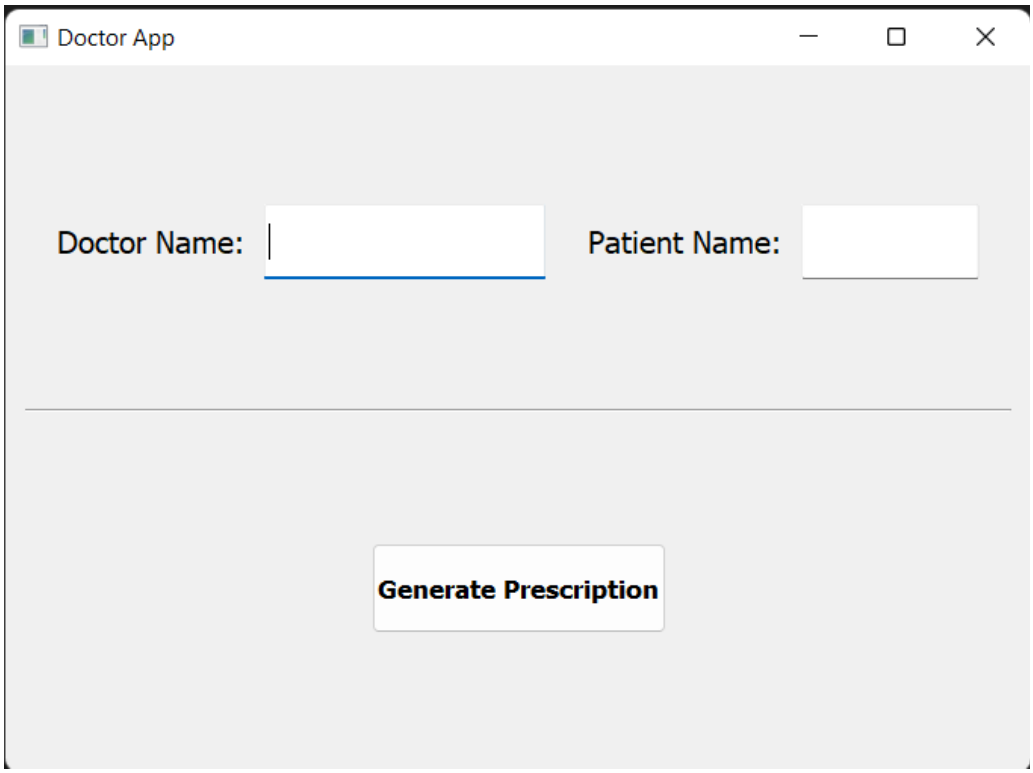
Circuit



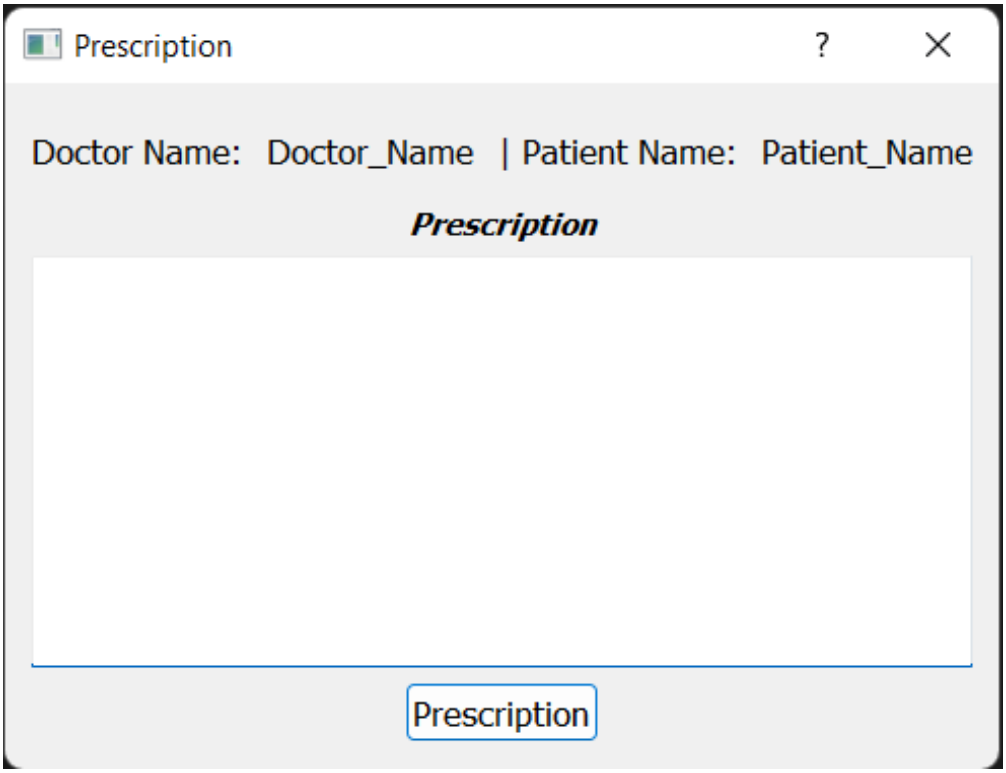
Load cell in the base



Sample printed prescription



General User Interface for Doctor to start session



General User Interface for Doctor to give prescription after diagnosis