Internet of Things Powered Automated AI-Enabled Medical Kiosk

Mayur Ramgir

mramgir@zonopact.com
CEO, Zonopact, Inc. & Founder of EverythingTech

Abstract- IoT Powered Automated AI-Enabled Medical Kiosk is a completely automated medical sysstem and a remote-controlled device with various sensors that aim to give medical access even to remotest parts of the world where medical facilities are not well developed. This could save countless lives, as people from such places are not able to get medical attention on time. The patients will be able to access the most qualified doctors even if they are from a remote place, able to send their diagnostic reports and counter their condition 24/7[2].

Index Terms- IoT, IoT AI in Medical, Automated Medical System, Medical Innovation, Sensors, Flexible Health Checkup, Healthcare.

I. INTRODUCTION

Every year countless people lose their lives due to lack of medical facilities in the rural areas. In fact, more than 30% percent of the rural population has to travel over 100 KMs to get proper medical treatment. This could be even worse for the people living in the most remote part of the world. There are general physicians, but there are no specialists who can handle advanced problems. For this reason, there is a need for inventing an Automated AI-Enabled Medical Kiosk, which is quite different from the existing remote health systems available in the market. It is like a 360 medical solution for patients who are not getting medical attention. It is a remote-controlled device with various sensors for blood pressure, weight, body temperature, ECG, ultrasound, pulse rate monitor, blood test, blood sugar levels, urine test, X-ray and eye check. The cloud-based system will allow doctors from any part of the world to help patients from anywhere [5][7].

Already, the world is facing a major medical crisis of medical professionals. The remotest villages are still devoid of proper medical facilities. Any epidemic means guaranteed death without medical attention. It is not possible for the doctors to navigate to the epidemic affected area and risk their own lives. For this reason, many doctors would refuse to visit such an area to help a patient. Automated AI-Enabled Medical Kiosk could be the solution to this critical problem. The patients could visit a regional center where an Automated AI-Enabled Medical Kiosk device is installed; the medical professional would remotely diagnose the patient's medical problem and provide automated medicine delivery at the doorstep[10].

The patients will not need to travel hundreds of kilometers to the nearest city in order to get medical attention. This invention can greatly affect life expectancy in rural areas. Most of the people will find prevention and cure to their medical conditions.

It will also greatly help the doctors to stop the epidemics of infectious diseases without risking their lives[9].

II. MATERIALS AND METHODS

A. Internet of Things
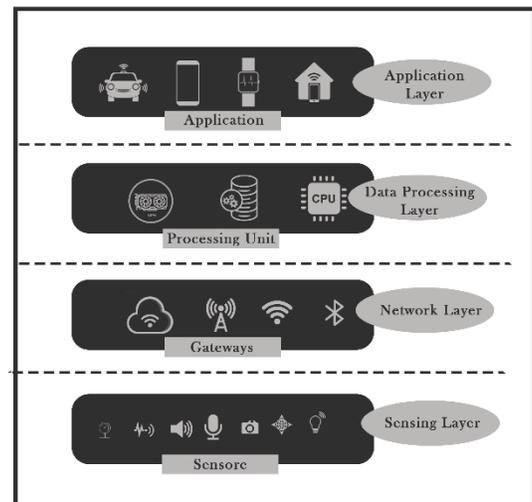
It means a world of interconnected objects that are uniquely addressable. Components like RFID tags, sensors, actuators, mobile devices, etc. are making it possible to have an interconnected world. The Automated AI-Enabled Medical Kiosk is also dependent upon these interconnected devices. IoT makes it possible to develop a huge number of applications, which can be used in different domains. IoT-enabled medical devices help medical professionals to easily identify diseases and medical conditions to provide treatments in a timely manner from remote locations. Many healthcare facilities have already started to adopt embedded solutions for medical devices enabled with IoT to tackle the lack of availability of doctors in remote areas. These devices also reduce the time to diagnose and treat patients effectively as these devices run on a high-speed processor with a feature-rich operating system interface. These devices

are capable of storing data of each patient on the cloud for different analysis and diagnosis purpose on a repetitive basis.

These IoT medical devices function by connecting to various hardware for inspecting diseases. The majority of the IoT medical devices has a touchscreen interface for users and medical professionals. After analyzing the input provided by the user, a disease or a condition is detected by the embedded medical device. Then it searches for generic medicine information pre-loaded prescription file of the device. Lastly, the medicines will be either dispensed immediately from the machine or will be delivered straight from the nearest warehouse [1] .

B.   Artificial Intelligence

AI or Artificial intelligence devices are meant to simulate human thinking capabilities in order to fulfill repetitive or complex tasks. AI-based programs and systems have the ability to gather information, utilize logical policies to process data, recognize and correct mistakes. These AI-based systems have opened up new possibilities in the medical industry. They have assisted the doctors to work more efficiently than ever before [3].

Today, medical device manufacturers are using AI technology to truly innovate their products to better help healthcare providers and to improve patient care. Software as a medical device (SaMD) has the real potential to adapt and normalize device performance to improve health care for patients. From diagnosing diseases to therapeutic applications and robotics, the potential of AI is almost reaching every corner of medical science. The Automated AI-Enabled Medical Kiosk also relies upon AI technologies to smartly generate prescriptions and treatment for the patients. These AI 'medical machines' will be faster, more efficient, cheaper, and able to handle much larger workloads than humans. AI is a technology that not only can improve, but can itself to become better. Earlier, medical AI-enabled devices have been sold in a 'locked' state. This means that they were unable to learn any further than their existing training sets. However, this ignored one of the largest benefits of AI: its ability to self-improvement [3][4][8][10]. Here's a diagram to explain how AI works:
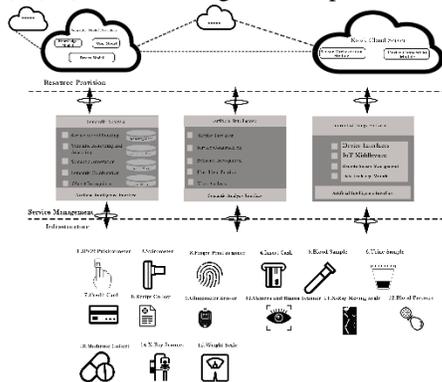
C.   Sensors

Multiple sensors have been used in IoT Powered Automated AI-Enabled Medical Kiosk. It consists of X-ray moving module, ultrasound sensor, blood pressure sensor, ECG sensor, weight scale, SP02 Pulsioximeter, spirometer, blood and urine sampling sensors, glucometer sensor, fingerprint scanner, and a camera sensor with retina scanner. All the sensors have been calibrated together to work in a unified Linux based operating system[10].
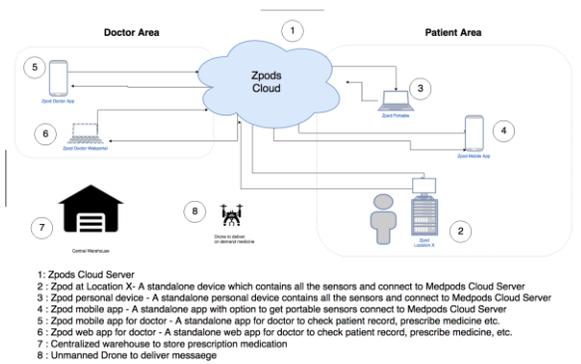
III.   THE RESEARCH AND DESIGN

The research behind this invention was quite intensive. It was quite difficult to find out how so many sensors and devices would work together in one single unified device. First, intensive study about all of the similar existing systems, devices, and sensors, which provides some level of automation. Then, there was the task to figure out different sensors modules and to be connected together in order to form a single device. Installing all the sensors and devices into a Linux based system was a lengthy and tiresome job. Below are some of the important highlights and features of Automated AI-Enabled Medical Kiosk[6].
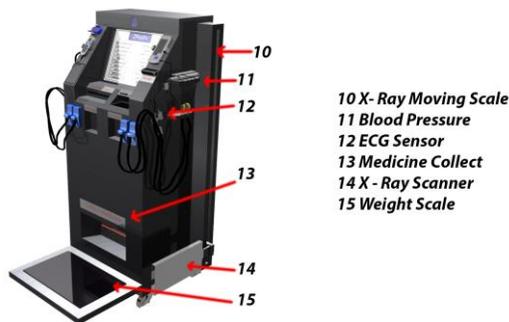
1.   It has a remote-controlled ultrasound belt, which can be operated without any trained technician on-site.
2. It has automated remotely controlled movable X-ray, which can be operated remotely without any trained technician on-site.
3. It consists of urine and blood sample processors to get basic readings to help identify health conditions.
4. The cloud-based system allows any part of the doctors to help any part of the patients.
5. It has an automated medicine delivery mechanism to make sure the remote areas get essential medical delivered at their doorsteps.

Here are some diagrams, which explain the IoT Powered Automated AI-Enabled Medical Kiosk design better:

1.   Figure 1. This figure shows how multiple devices are connected together with the help of the cloud. Both patients and doctors can access Automated AI-Enabled Medical Kiosk services through the mobile app and web portal. The Automated AI-Enabled Medical Kiosk standalone device with all the sensors is also connected to the cloud server. This device sends all the necessary information about the patients to the doctors remotely with the help of cloud technology. By using the mobile app or web portal a doctor can check the patient record, prescribe medicine, etc. The central warehouse is used for storing the prescribed medicine. Lastly, an unmanned drone is used to deliver the medicine at the doorstep of the customer.

1: Zpods Cloud Server
2 : Zpod at Location X- A standalone device which contains all the sensors and connect to Medpods Cloud Server
3 : Zpod personal device - A standalone personal device contains all the sensors and connect to Medpods Cloud Server
4 : Zpod mobile app - A standalone app with option to get portable sensors connect to Medpods Cloud Server
5 : Zpod mobile app for doctor - A standalone app for doctor to check patient record, prescribe medicine etc.
6 : Zpod web app for doctor - A standalone web app for doctor to check patient record, prescribe medicine, etc.
7 : Centralized warehouse to store prescription medication
8 : Unmanned Drone to deliver messaege

2. Figure 2. This figure demonstrates the various sensors that are attached to the Automated AI-Enabled Medical Kiosk machine. It is a single consolidated machine that can do multiple jobs. People can have their X-ray, blood pressure, ECG, weight, blood sugar, etc. checked with this single device. The Automated AI-Enabled Medical Kiosk device will communicate with its proprietary cloud, so the doctors can analyze and suggest recommended treatment and medication to the patients. This Automated AI-Enabled Medical Kiosk machine can be installed to any remote location easily. It just needs internet connectivity to function.

10 X- Ray Moving Scale
11 Blood Pressure
12 ECG Sensor
13 Medicine Collect
14 X - Ray Scanner
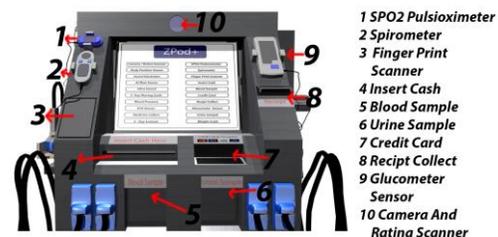15 Weight Scale

IV. ADVANCED FEATURES

This Automated AI-Enabled Medical Kiosk machine is the only remotely doctor controlled machine with so many sensors and different technologies. This device has the following advanced features, which makes it different from the rest of the devices:

1. **Remote-controlled ultrasound:** There is a hollow belt, which contains a remote-controlled ultrasound probe. The probe can be controlled remotely to move up and down to scan the patient. The pressure can also be controlled to obtain the best ultrasound images from the patient's body. This belt can be changed to various sizes, shapes, and materials. Therefore, it will not be necessary to have a trained professional/technician at the premise during its operation.

2. **Remote-controlled X-ray:** Having a clear X-ray is one of the hardest things in a medical institution. This device has an X-ray module attached to its side. It can be remotely controlled to move up and down by an X-ray specialist. Thus, we will not need to have an on-site X-ray specialist at the Kiosk location. This can greatly help people from remote places, where no qualified medical professionals are available.

The device is also connected with a camera, fingerprint scanner, retina scanner, printer, microphone, speaker and a touch screen.

3. Figure 3. This figure demonstrates the other devices and sensors connected to the device near the user console. The Automated AI-Enabled Medical Kiosk has a camera sensor to provide video call facilities and capture the face of each patient to manage his/her profile. It also has a fingerprint sensor and a retina scanner for a secure authentication process. The patients can use the credit card module for their payments. However, they can also insert cash for the payment. The SP02 Pulsioximeter form the machine can be used for measuring the oxygen levels in the blood and the spirometer is for measuring the ventilation patterns in the breathing. Patients can also submit their blood and urine sample to the machine for analyzation. There's a glucometer sensor attached to the machine to measure blood sugar levels of patients. After the check-up and the payment, patients will be able to collect an auto-generated receipt from the machine[1].

1 SPO2 Pulsioximeter
2 Spirometer
3 Finger Print Scanner
4 Insert Cash
5 Blood Sample
6 Urine Sample
7 Credit Card
8 Recipt Collect
9 Glucometer Sensor
10 Camera And Ratina Scanner

The display is very useful for displaying important information and presenting guides that instruct the patients how to place the sensors during their operation. The camera, microphone, and speakers are used for video calling medical professionals in certain situations. The patient record will be maintained once a patient has registered to the Kiosk. Medicines will be given to the patients from the device itself. However, if the medicine is not present in the machine, then it will be delivered from the nearby warehouse via an unmanned or manned vehicle. This entire process of the device almost presents a 360-degree medical solution for patients.

V. CONCLUSION

The IoT Powered Automated AI-Enabled Medical Kiosk can become a revolution in the healthcare industry. So many people do not get medical attention in time, as they do not have access to medical facilities and doctors. Patients with a chronic disease like cancer can have regular health checkups without the need of traveling for a hundred kilometers.

The shortage of doctors can also be dealt with this device, as doctors can be remotely present in different locations with the

help of video calling facilities. A doctor can check patients from different locations without being present there physically[2][9][10].

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