UPASANA: Diagnostic Toolkit for ASHA Worker

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***Abstract*—Upasana is a non-invasive medical diagnostic toolkit designed to be used by ASHA workers so that they can measure the vital parameters of the patients in rural areas and transfer the data to the doctors at the hospital for diagnosis.**

Keywords—ECG; Blood Pressure; SpO2; Hear rate; Body Temperature; ASHA workers

I. INTRODUCTION

Majority of the doctors, nurses and pharmacists prefer to work in cities where the quality of life is better. As a result, people in rural areas often need to travel long distances to get quality healthcare which is unaffordable.

We visited a few villages and came to know that as a part of National rural Health Mission (NRHM), an ASHA worker has been appointed in every village to do a basic check-up of all the people in her village.

We wanted to improve the healthcare services provided by the ASHA worker in the rural areas and hence decided to make UPASANA-A Diagnostic toolkit for ASHA worker which can measure the following parameters non-invasively

1: ECG (Electro Cardiogram)
2: SpO2 rate (Saturation of Peripheral Oxygen)
3: Pulse Rate
4: Blood Pressure
5: Body Temperature

The ASHA worker will visit all the villagers in her village one by one. She will connect the electrodes from UPASANA to the body of the patient. Then she will assign a unique ID to the patient using the numeric keypad provided in the device. After ensuring that the patient is not moving and is seated comfortably, so that the medical artefacts are reduced, the ASHA worker will press the MEASURE button. With just one button the readings from all the devices will be taken automatically. Thus it is simple for the ASHA worker to understand and use. Also we have provided an mp3 player which will play pre-recorded instructions, so that the ASHA worker can learn to use the device. The language of the instructions can be chosen by the ASHA worker. After measuring all the biomedical data, it can be stored in the device memory by pressing the STORE Button. This device logs the data samples along with time stamp and a unique ID that identifies the patient. Later on the ASHA worker can go to a nearby Primary health care centre having internet access and transfer the data stored on the device to a cloud storage such as Google drive. In order to transfer data to the computer via the LAN cable the TRANSFER button has to be pressed. Doctors can remotely access this data and he can analyse it to identify health conditions. The software interface was created so that both the ASHA worker and the Doctor can use the same platform with unique login ids and password to upload and view the data respectively. In case the doctor finds some abnormalities, he can ask the ASHA worker to bring the patient to the hospital or else he can give instructions to the ASHA worker on how to diagnose and give proper treatment to the patient concerned.

By using UPASANA we believe that the villagers will be spared from visiting the DOCTOR in faraway cities for minor issues and instead can consult the ASHA worker.

The flowchart showing how UPASANA can be used by the ASHA worker is represented in fig. 1

Fig 1 Flowchart showing the Process

II. PRINCIPLE

The principle used for measuring the various biomedical parameters are explained below

Pulse oximetry is a non-invasive method for monitoring a patient's oxygen saturation. **SpO2** is measured using finger probe and TI's AFE4490. The device used is shown in fig 2.

Fig 2 SpO2 Probe

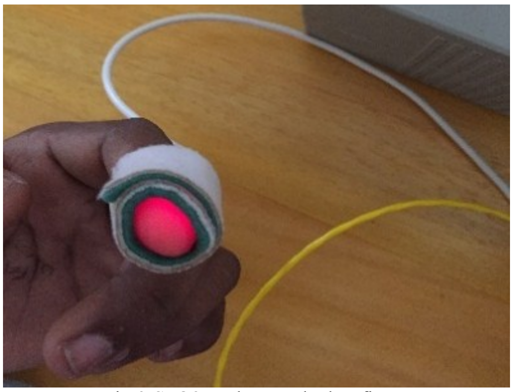

Fig 3 SpO2 Probe attached to finger

Light of two wavelengths is passed through the patient's finger to a photo detector as shown in fig. 3. The variations in the light absorbed at each of the wavelengths is measured, allowing determination of the SpO2 (Peripheral capillary oxygen saturation. Normal blood oxygen levels are considered 95-100 percent. The peaks in SpO2 data also gives the **Pulse rate** reading.

Blood pressure (BP) is the pressure of the blood in the arteries as it is pumped around the body by the heart. Blood pressure is recorded as two numbers- the systolic and diastolic pressure. Ideally, we should all have a blood pressure below 120 over 80 (120/80). An inflating deflating cuff along with a pressure transducer is used to measure BP as shown in fig. 4.

Body temperature is measured using a precision thermistor as shown in fig. 5. Average body temperature of a healthy individual is 37 degree Celsius.

Fig 4 Blood Pressure Monitor

Fig 5 Precision Thermistor

III. SYSTEM DESIGN

We designed the device in such a way that it will be easy for the ASHA worker to use. The entire system was enclosed in a box (fig. 6) with only the connectors required for connecting the measuring instruments kept outside (fig. 7). Fig. 8 shows the block diagram of the system. We have used an Arduino Atmega 2560 microcontroller on Arduino mega board as the processor of UPASANA. We used serial communication and I2C communication for interfacing and communicating with the devices.

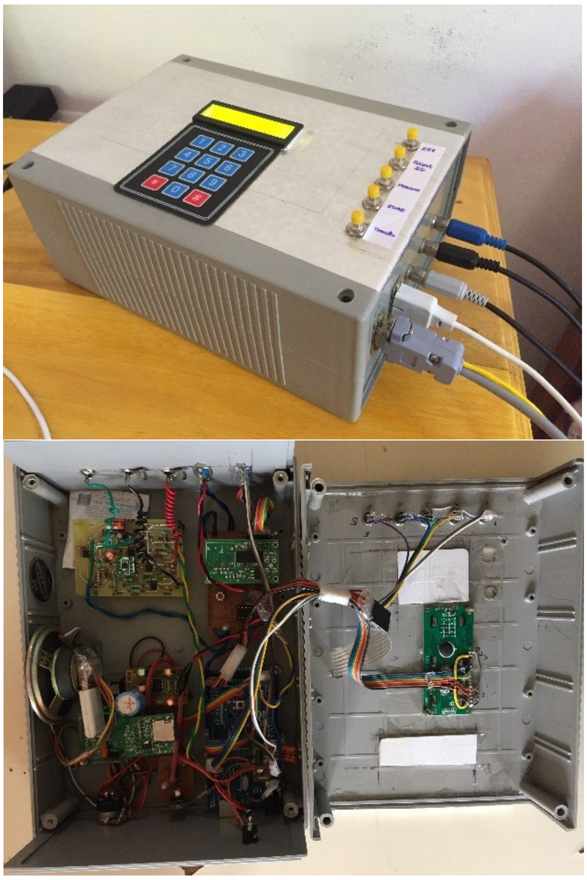

Fig 6 UPASANA Kit

Fig 7 Left and Right side views

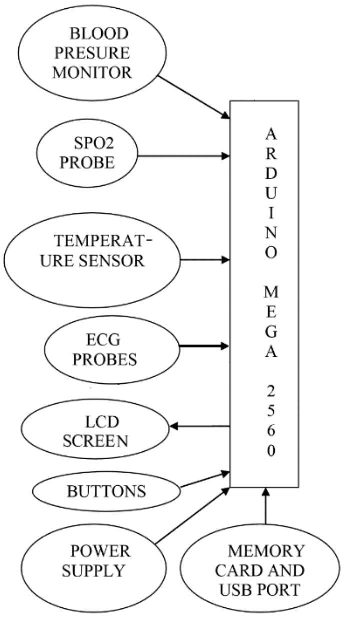

Fig 8 Block Diagram of the System

SPI interface for communicating with the memory card. Serial interface with BP monitor. ADC interface for thermometer. For SpO2 we have used an ADC port. For LCD we used a 6 bit parallel interface. We have used power supply decoupling capacitors. We have also given a provision for powering the device using a 3.7 volt lithium battery. We used TI's dc dc convertor PTN4050C to convert the 3.7V to 12V .We have used a low drop out regulator to power subsystems.

IV. SOFTWARE IMPLEMENTATION

We programmed the Arduino mega 2560 microcontroller using Arduino IDE.

The application for the doctor to view the patient data as well as for the ASHA worker to upload data to the cloud from the device was developed using Visual Basic. Fig. 9 shows the screenshot of the login window for the Doctor and ASHA worker. Fig. 10 shows the screenshot of the window when the ASHA worker logs in. She needs to create a new patient ID and type in the patient details before uploading their medical data from the device to the cloud. Patient ID creation is only a one time process. Afterwards only the updated data needs to be uploaded periodically. Fig. 11 shows the screenshot of the window when the doctor logs in. He can type in the patient ID and view the patient medical data.

The NEXT and PREVIOUS buttons are used to increment and decrement the patient ID number. JUMP TO button is used to quickly jump to that patient ID's details. CREATE button is used to create a new patient ID file. SEND button is used by the doctor to send a message to the ASHA worker requesting her to bring the patient concerned to him immediately when some serious problem is found with the patient's medical data

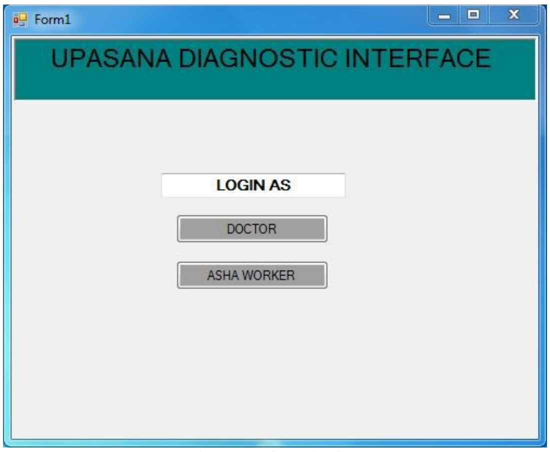

Fig 9 Login Window

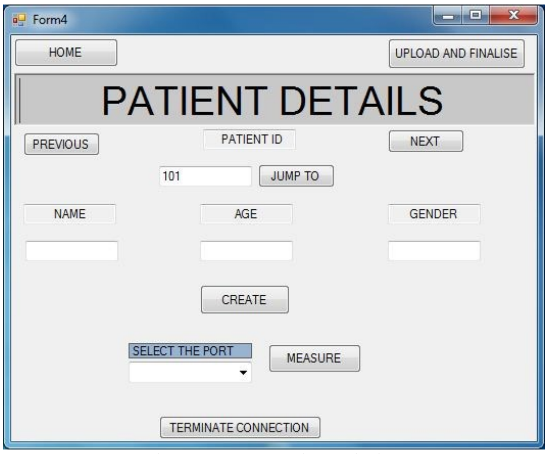

Fig 10 ASHA worker Window

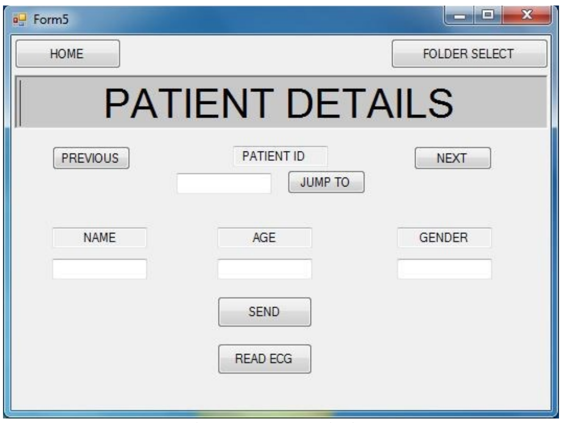

Fig 11 Doctor Window

V. FUTURE WORK

Currently we have interfaced only a SpO2 probe, a Blood Pressure Monitor and a Thermometer. For making a low cost ECG circuit, we fabricated a PCB (Fig. 12) using TI's INA333 instrumentation amplifier and 4 OPA 333 OPAMPS as buffer and filter circuits to remove noise. However due to ground loop, parasitic interference and offset voltages, instrumentation amplifier goes into saturation. So we are currently working on ADS 1298 based 12 channel ECG acquisition system.

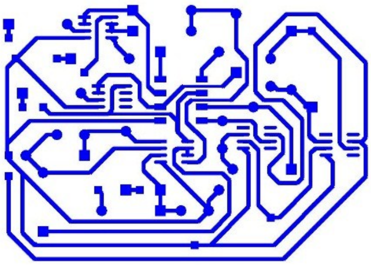

Fig 12 PCB Layout

VI. RESULTS

We carried out field test with random patients using the device and measured the Pulse rate, SpO2 level, blood pressure and Body Temperature of a few patients at Snehaveedu, Nalanchira (fig. 13) and found that the device showed readings which were within the normal range (fig. 14). This is only a prototype. After perfecting the ECG circuit, we plan to make a medically approved UPASANA Kit with which further tests will be carried out.

Fig 13 Field Testing Photo

Fig 14 Device showing readings of one patient

VII. CONCLUSION

We believe that by equipping each and every ASHA worker in India with UPASANA, we can provide cheap quality healthcare to the people in rural areas.

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