THE TECHNOCRACY
STUDENTS' TECHNICAL COMMITTEE, NIT RAIPUR

AAVARTAN 24-25

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DEPARTMENT OF BIOMEDICAL ENGINEERING

PROBLEM STATEMENTS

BME01: Developing easy to use portable radiological device(X-RAY)

The doctor asks the patient to go for an X-ray and wait until the results are available.This delay can be 2-4 hours for the same hospital Radiology Lab if not then In remote areas it can take 1-2 days. The patient has to suffer by that time.

Current issues and limitations :

- Getting the X-ray images from Radiology to orthopaedic OPD leads to treatment delay.
- High cost of equipment and the shortage of qualified manpower to operate the equipment and interpret the findings.
- The number and type of examinations carried out may have to be limited in some very sick patients because they reach their limits of endurance. Practically every procedure therefore has to be a compromise.

Future scope and impacts:

- These (Digital X-ray) machines produce 80% less radiation.
- They offer greater efficiency – with digital technology
- Allowing the quick production of images, ease of transmission to your doctor, and unlimited storage of data. It is efficient, cost-effective, and even safer than traditional X-rays.

Expectations from the team:**(**Overcoming the current issues**)**

- The task involves building a Portable X-ray device that is needed to be used as a Point-of-care device at Orthopedic OPDs and remote areas for teleradiology to fasten the process of getting X-ray images in emergency care. These X-ray images should be in .png/.Jpg format & accessible/shareable on mobile phones and free from compulsions like DICOM or PACs**.**

BME02:AI-powered microscope to check cancer margins.

Tumours are removed with some extra margin to avoid regrowth and future complications. But deciding the cutting depth is a challenge for(especially, oncology) surgeons. Hence marking the region before operating becomes essential for ensuring a curative resection, accurate prognostication, and for sparing of healthy tissues.

Current issues and limitations:

- Cutting extra tumour margin leads to unnecessary complications & pain for patients and cutting fewer leads to higher chances of getting a tumour again at the same place then the patient has to undergo re-surgery
- Deciding the cutting depth is a challenge for the surgeons. It's purely based on experience and a sort of vague decision that takes place with no concrete evidence.
- No Assistive technology is available to help doctors decide the depth of the tumour margin.

Future scope and impacts:

- The modulation allows for better control of depth-dependent blur in the images captured by the microscope.
- That control helps ensure that the deblurring algorithms that are applied to the captured images are faithfully recovering high-frequency texture information over a much wider range of depths than conventional microscopes.

Expectations from the team:(Overcoming the current issues)

- The task includes the development of an AI-powered microscope for intraoperative assessment & identification of tumour margins and marking for ensuring a curative resection, accurate prognostication and sparing of healthy tissues.

BME03: Develop low-cost ABG machines that utilize generic chemicals.

By creating an affordable and sustainable ABG analysis solution, healthcare providers can enhance patient care and diagnosis while ensuring equitable access to vital medical testing in diverse healthcare settings without compromising the accuracy and reliability of the test results.

Current issues and limitations:

- The current landscape of arterial blood gas (ABG) analysis is hindered by the high cost of specialized reagents and consumables required for the accurate measurements of parameters.
- The financial barrier is restricting the accessibility of ABG testing for healthcare facilities, particularly in resource-limited settings where cost-effective medical solutions are crucial.
- The reliance on proprietary chemicals and components further exacerbates the affordability issue, impeding the widespread adoption of ABG machines. To address this challenge, there is a critical need to develop low-cost ABG machines.

Future scope and impacts:

- ABG commonly used in ventilators measures the acid-base status, ventilation, and arterial oxygenation in the patient, it being cost-effective can aid the hindrance in accessing the ABG testing due to financial barriers.
- Would increase the convenience of monitoring critically ill patients in the ICU under ventilators or other critical care settings.

Expectation from the team:(Overcoming the current issues)

- The task includes the development of low-cost ABG machines that utilize generic chemicals and easily accessible consumables, without compromising the accuracy and reliability of the test results. By creating an affordable and sustainable ABG analysis solution, healthcare providers can enhance patient care and diagnosis while ensuring equitable access to vital medical testing in diverse healthcare settings

BME04:Develop specific ECG electrodes for Pulmonary Edema

Pulmonary oedema is a condition caused by excess fluid in the lungs. This fluid collects in the numerous air sacs in the lungs, making it difficult to breathe.

Current issues and limitations:

- In most cases, heart problems cause pulmonary oedema. Since it's related to heart problems, a patient's ECG is needed to proceed with treatment which becomes difficult.
- Echocardiography in pulmonary edema for emergency admission is difficult or impossible since ECG signals don't come properly due to fluid inside the lungs which delays treatment for some days.

Future scope and impacts:

- Echocardiography in pulmonary oedema for emergency admission would become convenient due to the presence of specialized ECG electrodes which can measure the required parameters despite the fluid in the lungs.
- Would be capable of detecting signals from pulmonary edema-affected chest area without getting distorted due to fluid in the lungs.Enhancing the precision and adequacy in the patient's treatment.

Expectation from the team:(Overcoming the current issues)

- The task involves the need to develop a specific type of ECG electrodes that can detect signals from pulmonary edema-affected chest without getting distorted due to fluid in the lungs.

BME05:Develop a hospital-specific EHR

EHR(Electronic Health Record) can be used for securely sharing electronic information with patients and other clinicians, as paper files can easily get lost or misplaced, causing serious problems for the patient down the line.

Current issues and limitations:

- ESI hospital uses Electronic Hospital Records but not efficiently as told by the officer.
- Causes inconvenience when every month Government asks for communicable disease data: IMR, MMR, Tubectomy, TB, Cataract, Spine Flue, Vita
- Patient data worth millions is just kept there for 10 years and after that will be sold to ITC for paper recycling.

Future scope and impact:

- Securing these huge medical data can be utilized for training AI/ML models after converting them into a structured form.
- Improves patient and provider interaction and communication, as well as health care convenience. Enabling safer, more reliable prescribing.

Expectation from the team:(Overcoming the current issues)

- The need of the task is to have a hospital-specific EHR for securely sharing electronic information with patients and other clinicians. Helping providers more effectively diagnose patients, reduce medical errors, and provide safer care. Improving patient and provider interaction and communication, as well as health care convenience. Enabling safer, more reliable prescribing. Securing it from unauthorized people who may also get their hands on these paper files if left out in the open which can cause various medical discrepancies.

BME06:Develop infusion & feeding pumps carrying multiple syringes and feeding bags.

Using a higher number of infusion & feeding pumps (generally more than 5) on a single patient leads to several problems for nursing staff monitoring all at certain intervals, regulating the flow rate, reinjection when the patient pulls out and noting down the data manually on ICU chart sheet.

Current issues and limitations:

- Sometimes ICU lacks Infusion pumps and they have to be brought from other departments.
- These pumps are not remotely monitored, creating confusion for nurses.
- Nurses have to use an individual pump for individual syringes.

Future Scope and Impact:

- Can provide the nurses with convenient monitoring at certain intervals, flow rate regulation and digital records preparation.

- Aids the lack or shortage of pumps in ICU during emergencies.
- This would reduce the average number of pumps used for a single patient

Expectation from the team:(Overcoming the current issues)

- The task involves the need for developing infusion & feeding pumps that can hold multiple syringes and feeding bags. Also can monitor at certain intervals, flow rate regulation and digital records preparation, to make it convenient for the nurses to work. No remote control & dashboard for these devices makes the nursing staff's work difficult in monitoring 100s of devices in the ICU.

BME07:Develop affordable, bedside exercising tools for post-surgery (knee).

Regular exercise to restore strength and mobility to your knee and a gradual return to everyday activities are important for your full recovery after total knee replacement. Your orthopaedic surgeon and physical therapist may recommend that you exercise for 20 to 30 minutes.

Current issues and limitations:

- Without proper exercise post-knee replacement, it creates stiffness, and scar tissue develops which leads to failure of the surgery or replacement.
- Since patients can't walk and it's not safe, bedside exercises are advised.
- Patients can't afford to buy these exercise tools at home so it also makes their hospital stay longer.

Future scope and impact:

- Will help the patient regain movement in their knee faster post-surgery.
- Increases the chances of the surgery to be efficiently successful.
- Will help the patient build strength in the muscles around the knee.

Expectation from the team:(Overcoming the current issues)

- The task includes the need for developing an affordable, bedside exercising tool for post-surgery (knee replacement surgery) patients to avoid replacement failures or re-surgery, focussing on the methods or ways by which the tools can be made easy to use by self for the patient.