LOG BOOK CYSF-2025

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Date: Sep-10-2024

When we went to India, we visited my dad's village—which is away from the city-and no hospital facility. And one of our relatives was suffering from stage-4 liver cancer.

My dad told me that, they had to go to the city for the treatment which is 40 km away from the village and the cancer treatment is very expensive and they cannot afford it.

Date: Oct-10-2024

In remote areas, access to essential medical infrastructure and necessary oncological professionals is limited. Due to this matter, the screening and diagnosis of cancerous tumours is often delayed by many weeks it allows cancerous tumours to metastasize quickly to many parts of the body, which allows liver cancer to grow 86% within 11 weeks (typical wait time).

How can we make a low-cost, fast, and effective portable multi-cancer screening system that can be set up anywhere, is nominal to remote communities, can be operated by anyone, and will provide results instantaneously?

Date: October-20-2024

I researched Current Cancer Diagnostic Methods and found out the Portable Ultrasound Research. I am planning to build a Portable ultrasound prototype for my project.

Based on research done thus far, to build a mock portable ultrasound, here are the necessary basic components.

1. **Ultrasound Transducer**

   A probe that emits sound waves and receives echoes to create an image, and different frequencies are available based on budget/required resolution.

2. **Pulse Generation Circuit**

   Generates short bursts of high-frequency electrical pulses that drive the transducer. Should include a timing component, a pulse amplifier, and a switching element to control signal transmission.

3. **High-Voltage Power Supply**

   Converts a lower voltage input to the **higher voltage needed** to excite the transducer.

4. **Signal Reception and Processing Circuit**

   Captures the returning echoes and amplifies the weak signals. Should include amplifiers, rectifiers, and filtering components to extract useful data.

5. **Microcontroller**

   Controls the timing of pulses and synchronization of the signal, collects them to create the image. Must have a high analog-to-digital conversion rate in order to create the image in real time.

Date: November-04-2024

In my school, I went for the science fair meeting.

Date: November-07-2024

I emailed my question to my teacher.

How can we make an AI-powered portable multi-cancer screening system?

Date: November-10-2024

Hardware Required

To train and deploy a real-time AI model for the portable ultrasound, there are some hardware requirements.

Firstly, the computer must be small, and easily portable so that it would not increase the size of the overall device and keep it accessible to remote communities.

Additionally, the computer must be able to at least have 4GB of RAM (Random Access Memory) and be able to compute AI tasks easily and efficiently.

For this project, I have selected the Jetson Nano Developer Kit with 4 gigabytes of RAM.

Date: Nov-14-2024

Proposed Solution:

My proposed solution is to create a portable, accessible, and nominal ultrasound device under $500 using basic components to be able to generate imaging from human organs and also run real-time object segmentation via the Jetson Nano 4GB to find tumours from the ultrasound scan.

The ultrasound will work via a transducer taken from a paint thinner, chips to amplify the signals, and the Teensy 4.1 microcontroller to piece together the image based on the signals from the chips. After that, the real-time ultrasound feed would be sent to the Jetson Nano via USB serial, which would run my trained YOLOv8 tumour segmentation model in real-time. Finally, the results of the segmentation program would be displayed on a Streamlit web app, accessible by a device on the same network.

This proposed solution offers a more effective way to screen for cancer tumors by using a portable ultrasound device powered by an artificial intelligence neural network. The device is designed to cost under $500 and will be easy to use, even for individuals without advanced experience.

Date: Nov-20-2024

Materials and costs:

Seq #	Material (Item Name)	Qty	Purpose/Use	Cost CAD	Notes
1	LM7171BIN/NOPB	1	Voltage feedback op amp	$ 8.41	Texas Instruments, DIP-8
2	AE9986 (IC DIP Socket 8-pin)	10	Socket for 8-pin DIP IC	$ 1.41	Assmann WSW Components, Tin contacts
3	1175-1487 (IC DIP Socket 14-pin)	1	Socket for 14-pin DIP IC	$ 0.32	CNC Tech, Tin contacts
4	SN74121N	1	Monostable multivibrator IC	$ 9.48	TI, DIP-14
5	IRL630PBF	1	N-channel MOSFET	$ 4.68	Vishay, 200V/9A, TO-220AB
6	ICL7667CPA+	1	Half-bridge gate driver	$ 13.41	Analog Devices/Maxim, DIP-8
7	LM7171AIMX/NOPB	1	Voltage feedback op amp	$ 7.27	TI, SOIC-8
8	AD811ANZ	3	Current feedback amplifier	$ 83.25	Analog Devices, DIP-8 (total for 3 units)
9	DFR0123 (XL6009 Eval Board)	1	DC–DC boost converter board	$ 11.40	DFRobot
10	TEENSY 4.1 (DEV-16996)	1	Microcontroller development board	$ 60.18	SparkFun
11	L7805CV	1	Linear voltage regulator (5V)	$ 0.81	STMicroelectronics, TO-220
12	ECQ-E2104KB (Film Capacitor, 0.1µF)	10	General decoupling/filtering	$ 2.90	Panasonic, 250V (total for 10 capacitors)
13	UCS2D470MHD1TO (Electrolytic, 47µF)	1	Power supply smoothing/filtering	$ 1.63	Nichicon, 200V

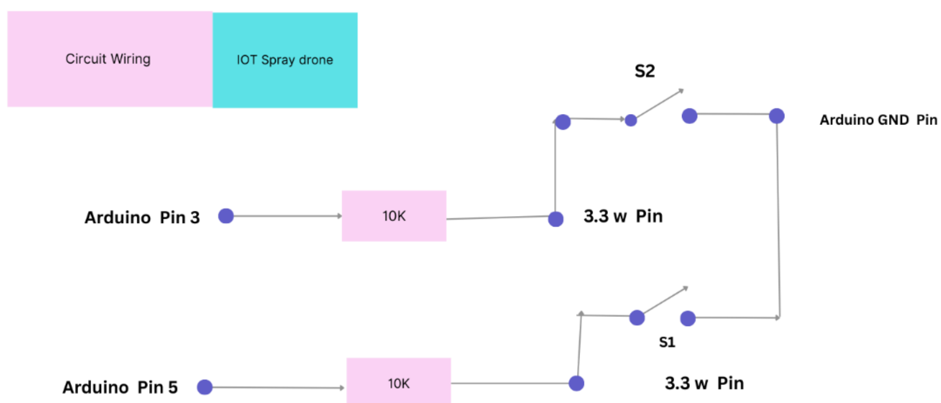
14	561R10TCCQ50 (Ceramic Capacitor, 50pF)	1	High-voltage circuit applications	$ 2.90	Vishay, 1kV rating
15	B32529C0102K289 (Film Capacitor, 1nF)	6	Filtering or timing circuits	$ 2.40	EPCOS/TDK, 63V (total for 6 capacitors)
16	TVA1442.1 (Electrolytic, 20µF)	1	Power filtering in higher-voltage applications	$ 11.29	Vishay Sprague, 200V
17	DEVMO 8–32V to 45–390V DC–DC High Voltage Boost Converter	1 module	Step-up booster for high-voltage applications	$ 21.99	DEVMO; ZVS step-up booster module
18	E-Projects Radial Electrolytic Capacitors, 0.1µF, 50V (Pack of 5)	1 pack (5 caps)	General decoupling/filtering in circuits	$ 8.71	E-Projects; 105°C rated
19	Wavelength MP Blue Multi-Purpose Ultrasound Gel (250 mL)	1 bottle	Ultrasound coupling medium	$ 10.55	National Therapy Products, Brampton, ON
20	Ultrasonic Thickness Gauge Probe, 5MHz, Dia 8 (Replacement Probe for GM130/GM100)	1 transducer	Measuring material thickness via ultrasound	$ 39.42	Fydun; suits GM130/GM100 gauges
21	Security-01 9V 1A Power Supply Adapter (Center Negative), 5.5×2.1mm	1 adapter	Power supply for center-neg. 9V devices	$ 14.65	Security-01; 6.8 ft cord; UL listed
22	Facmogu 9W 9V/1A Power Supply Adapter (Center Positive), 5.5×2.5mm & 5.5×2.1mm Plugs	1 adapter	Power supply for center-pos. 9V devices	$ 11.42	Facmogu; AC 100–240V input; multiple plug sizes
	Total			**$ 328.48**	

Date: Dec-05-2024

I have ordered the parts and waited to arrive. Now, I have the parts and tomorrow, I am planning to go the local store to get the soldering kit.

Date: Dec-10-2024

Hardware design:



Date: Jan-04-2025

AI Model Development

In order to build the neural network, there are three main steps. These steps are annotating the dataset, training the model, and finally deploying the software on the Jetson Nano.

1.Annotating the Dataset

Firstly, I needed to create data to train my machine-learning model on. For this, I did lots of research to find accurate databases of ultrasound images of breast, liver, and thyroid cancers.

2. Training the Model

Next, I train my model using the YOLO v8 neural network. To train it locally on my Jetson Nano, I first need to select a pre-trained model and retrain it with my own dataset to get faster results.

3 Software Deployment

Date: Jan-15-2024

I have discussed my project with Dr.Cenabre and he gave me some clinical insights about multi-cancer diagnosis.

Date: Feb-2 -2024

I am completing my projects with trial and error and analysis part.

Date: Feb-10-2024

I have recorded my video.