Temporal Distance Map:
A Warped Isochrone Map Depicting Accurate Travel Times

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Dr. Mark V. Albert
Director of UNT Biomedical AI Lab

Dr. Albert’s professional goal in life is to leverage machine learning to automate the collection and inference of clinically useful health information to improve clinical research. His projects in wearable sensor analytics have improved the measurement of health outcomes for individuals with Parkinson’s disease, stroke, and transfemoral amputations with a variety of additional populations and contexts including children with cerebral palsy as well as healthy toddler activity tracking. Current projects include video-based activity tracking and mobile robotic platforms, all in an effort to improve measures of clinical outcomes to justify therapeutic interventions.

Elijah Nacar
Undergraduate Student

Elijah Nacar is an undergraduate researcher currently enrolled in the Texas Academy of Mathematics and Science at the University of North Texas.

Devak Nanda
Undergraduate Student

Devak Nanda is an undergraduate researcher currently enrolled in the Texas Academy of Mathematics and Science at the University of North Texas.
People:
- Dr. Mark V. Albert
- 8 PHD Students
- 5 MS Students
- 11 Undergraduates
- 1 Affiliated Lab
- 4 Capstone Groups for Fall 2020

Mission Statement:
We use machine learning to advance medicine, with a history in wearable device analytics to aid clinicians in the treatment of mobility disorders, as well as broadly using AI to improve health outcomes.

A Few of Our Projects:
- Wearable-based Spasticity Prediction and Validation Using Machine Learning
- Activity Recognition
- Fall Detection and Real-time Response
- Assessing quality of activities
- Fall Prevention

ML Techniques
- Time of NO profile and unproven models
- Deep Learning (DNN, CNN, LSTM, and Tacotron)
- Reinforcement Learning
- Computational Neuroscience

Tweet from the Lab:
"Want to see how AI can improve medical care? Over the next month we’ll be posting about the 13 different presentations from our lab at 3 national conferences representing diversity in computing, rehabilitation, and biomedical engineering (ACM Tapia, ACRM, and BMES)! Stay tuned!"

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Introduction

Background & Purpose

- Travel Time is poorly represented on physical maps
- Most research has begun utilizing isochrone maps
- Isochrones depict contours that delineate distance
- We sought to create a tool that would morph the static image of a location to order to substitute distance on the map as the region's travel time

 Isochrone Map

Isochrone map showing drive times around airports in northern Finland, created using GIS software (2011)

All Code and Documentation can be found here: https://github.com/Debusan13/temporal-distance-map
1. Utilize the Bing Maps API to obtain both a static image of the location and the regions travel time from a central point
2. Overlay a mesh of points corresponding to Latitude and Longitude
3. Find travel time between the mesh of points and the central point
4. Transform the mesh of points to accurately represent travel time from the central point
5. Shift the pixels on the map accordingly
6. Overlay contours
Results: Pennsport
Results: Miami Bay
Results: Kansas City
Conclusions

- This transformation is more relevant to personal experience
- Allows the comparison of travel times at a glance
- Provides additional insight into the impact of geographic and infrastructural features
Towards a Dynamic Isochrone Map: Adding Spatiotemporal Traffic and Population Data


Discusses how an isochrone map could be further developed in terms of GIS

Isochrones, Traffic and DEMOgraphics


Noninvasive Electrocardiographic Imaging


The Victoria-Regina Stellar Models: Evolutionary Tracks and Isochrones for a Wide Range in Mass and Metallicity that Allow for Empirically Constrained Amounts of Convective Core Overshooting


Shows examples of how isochrone maps are being used in Geographic, Clinical, and Astrophysical Research