EMG Computer Interface

SDP Team 12

University of Massachusetts Amherst BE REVOLUTIONARY™

Meet SDP Team 12

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All parts of the project are worked on in collaboration

Introduction

According to a Princeton University study; there is a 2% chance of a COVID-19 level pandemic occurring each year.

It was found that in one's lifetime there is a **38% chance** that we will **live through a pandemic on the scale of COVID-19**. This probability may even increase in the next decades.

[Reference 7]

Problem Statement

- Pandemic is a wake up call for preventing the spread of germs/illness
- Precautions that we take include mask wearing, social distancing, and cleaning common surfaces.
- However the safest and most efficient way to keep surfaces clean is not to touch them, especially ones shared in public settings.
- Why not emphasize more touchless options?

While there are many products that allow for **touchless interactions** with computers, there are no comprehensive interfaces that allow the user to **navigate and interact with a computer** without touching any common screens or buttons.

Introduction to Our Solution

EMG Sensing

Computer Interface

Completing Simple Tasks in a Fun and Safe Way

What about other similar products and research?

University *of* Massachusetts Amherst

Survey 1: Air Keyboard

Positive Research Results

MyoWare + Arduino

Predictive Text

But the downsides...

No Product

Keyboard Focused

[References 1]

Survey 2: Tap Strap 2

Seems like a great product...	But reviews are mixed...
Easy-going Form Factor	Hard to Handle
Keyboard Interaction	Not Accurate
Gesture recognizable	Difficult to Learn
$200	$200

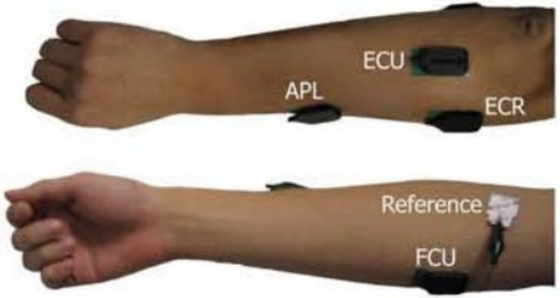
[References 2]

Survey 3: Real Time EMG-Based Assistive Computer Interface for Upper Limb Disabled

Unique elements

Focused on Disabilities

Neural Networks



Flaws?

No Customization

Mouse/Keyboard Focus

[References 3]

Competing Solutions

	Compatible with any computer	Non-Intrusive	Customizable profiles	Movements + Voice
Real Time EMG Interface				
Tap Strap 2				
Air Keyboard				
Our Solution				

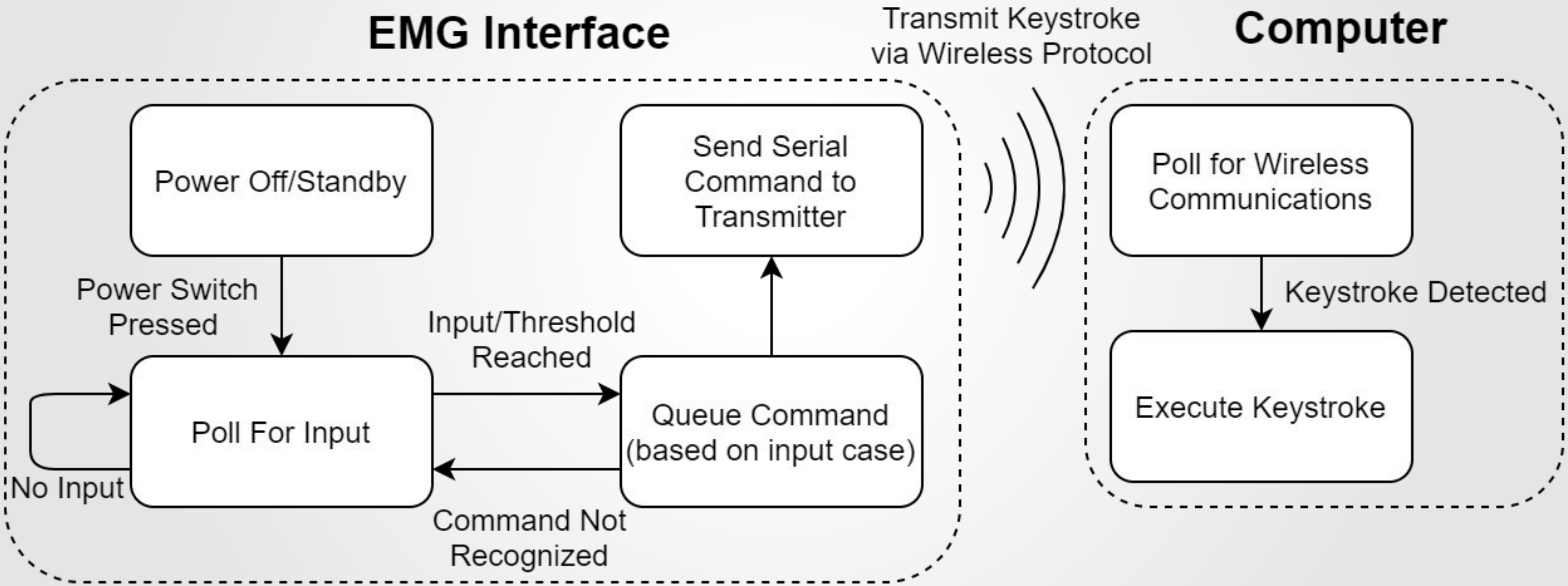
System Specifications

- Compatible with any computer that has access to wireless serial communication (Potentially add wired compatibility as backup).
- Utilize human movement and voice to interact with computers, terminals, and kiosks in public settings and accomplish a task (order library book, purchase train ticket).
- Enable customizable profiles for users to choose how to interact with various features and provide accessibility for those with disabilities.
- Ergonomic enough to be worn through the workday and not impede normal writing or typing capabilities.
- Connection time to an interface shall take less than 1 minute.
- Battery life sufficient for everyday use (3 hours actively using the device) and rechargeable.

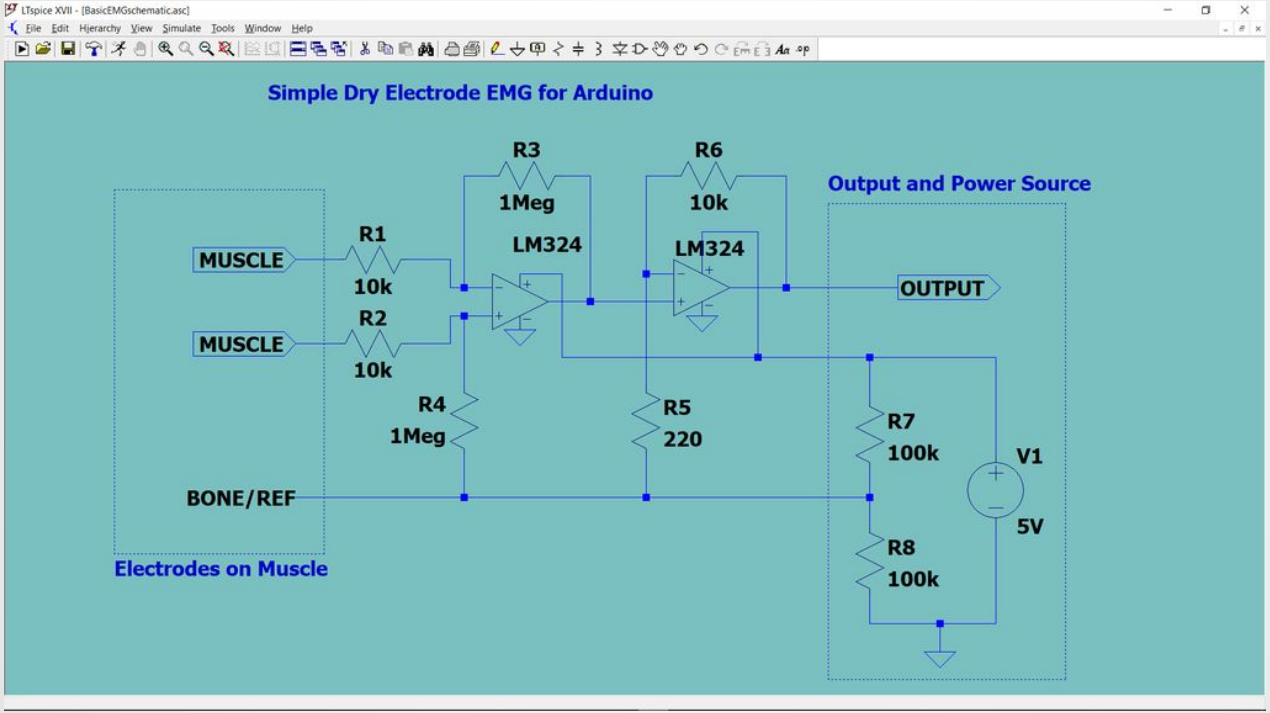
Verification Plan

1. Interface wirelessly with a computer in M5 to reserve parts or UMass library computers to check out a book.
2. Demonstrate the capability to customize and then switch to another interface profile.
3. Demonstrate writing a simple sentence on paper while wearing the device.
4. Test that the average connection time to the interface takes under a minute.
5. Demonstrate that batteries are rechargeable and sufficient for everyday use by actively using the device for 3 hours.

Software Block Diagram



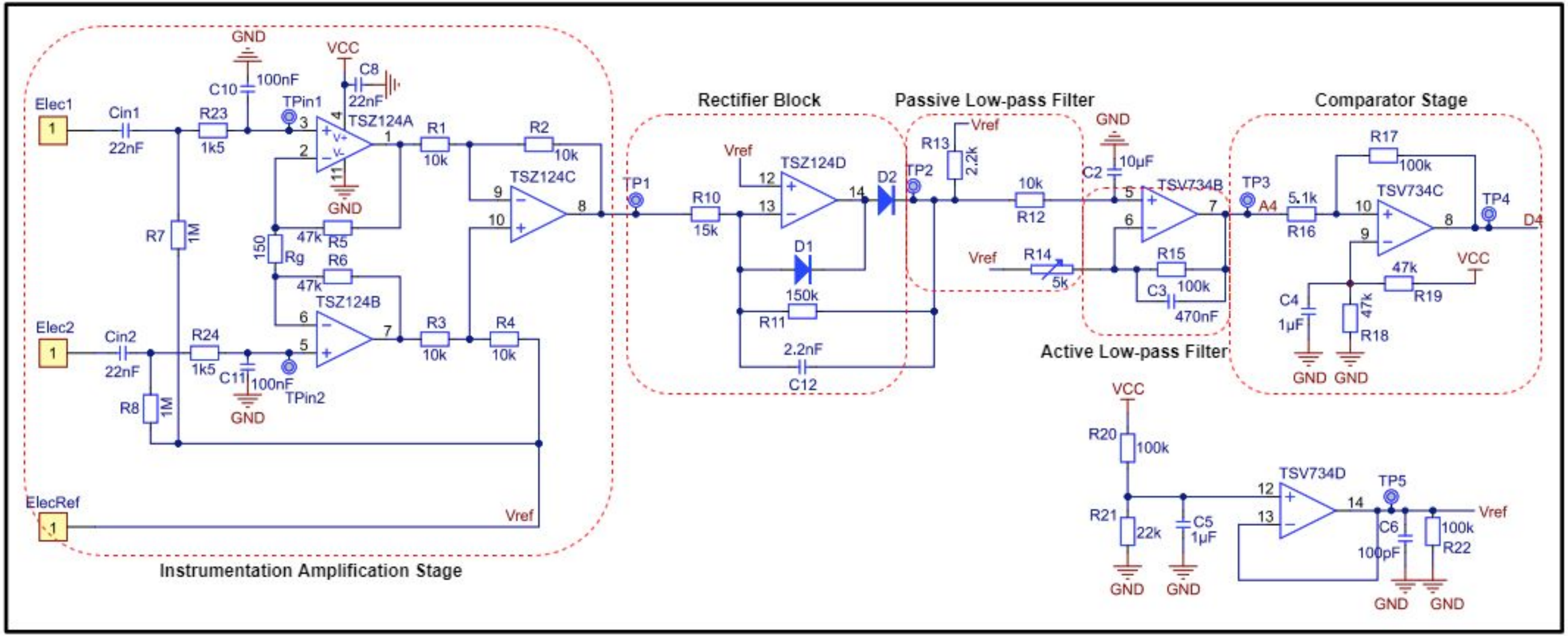
EMG Circuit Diagrams



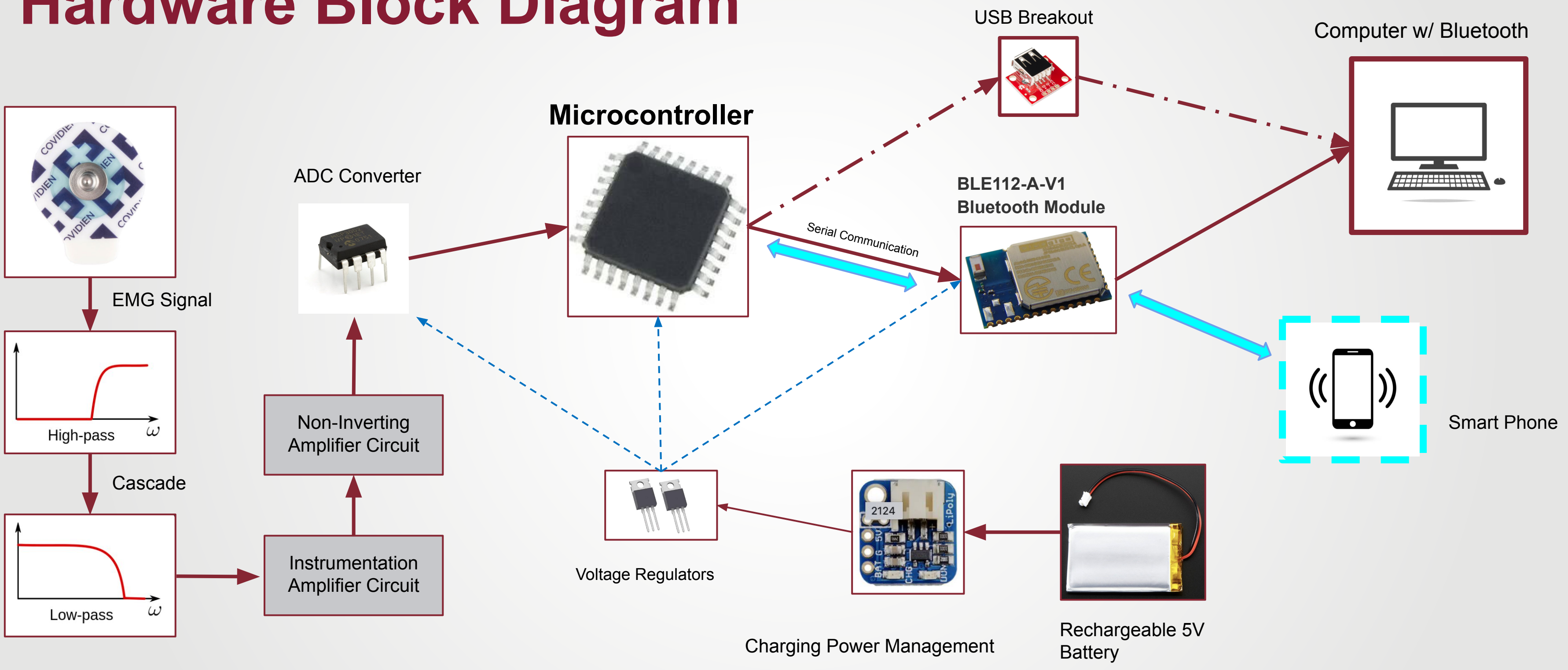
[References 5]

EMG Circuit Diagrams

[References 6]



Hardware Block Diagram

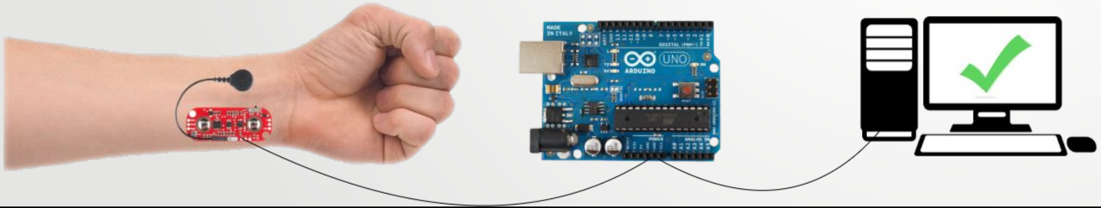


Budget Breakdown

Generic Name	Specific Name	Cost	MDR or FDR
Analog to Digital Converter (2 count)	ADS79	$10	Both
Microcontroller	ATmega328P	$15	Both
Bluetooth Module (2 count of each)	HC-05	$26	Both
	BLE112-A-V1	$54	FDR
Rechargeable Battery Setup	TBD, 2124 Battery Backpack	$70	Both
MDR Components (Op Amps, Resistors, Capacitors, etc.)	Misc.	$30	MDR
Myoware Sensor (2 count)	Sparkfun Myoware Sensor	$40	Both
Electrodes (120 count)	Versa-Trode Electrodes	$36	Both
Onboard Components (Op Amps, Resistors, Capacitors, etc.)	Misc.	$30	FDR
PCB	TBD	$70	FDR
TOTAL COST		**$381.00**	

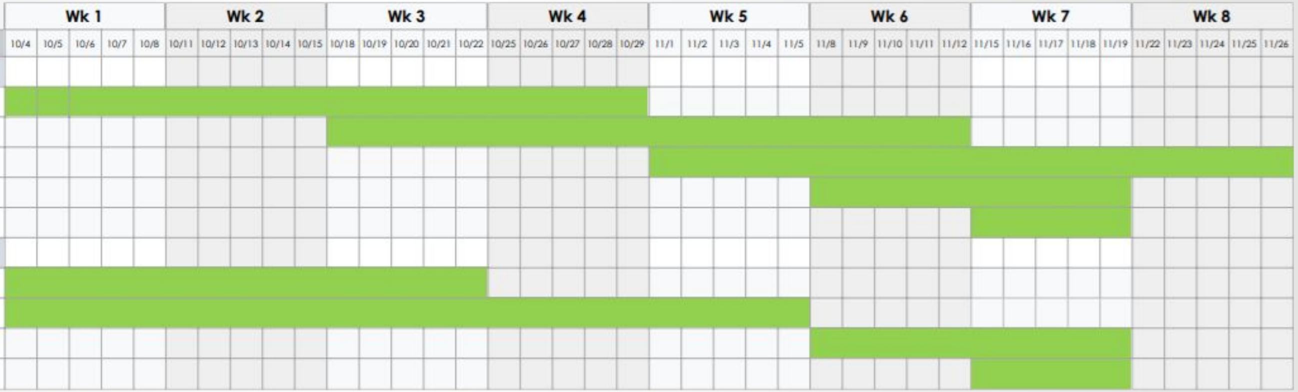
Proposed MDR Deliverables

- **Create custom analog EMG circuit that functions using electrodes**
  - Sense distinct, basic muscle movements using custom EMG circuitry and generate corresponding analog output
- **Demonstrate a functional analog to digital conversion subsystem**
- **Convert MyoWare input into distinct keystrokes sent to computer through wired connection via Arduino**
- **Demonstrate basic wireless subsystem between Arduino and computer**
- **Demonstrate rechargeable battery subsystem**



Gantt Chart

MDR Subsystem Review	TASK OWNER	START	END
Hardware		**10/04**	**11/29**
EMG Circuit Prototype	Sam	10/04	10/29
ADC System	Sam/Aidas	10/18	11/14
EMG Circuit Verification	Berke	11/01	11/29
Wireless Subsystem	Ryan	11/08	11/19
Rechargeable Battery System	Aidas	11/15	11/19
Software		**10/04**	**11/29**
Develop Basic Threshold Based Sensing	Aidas	10/04	10/22
Send Keystrokes from Arduino to Computer	Berke/Ryan	10/04	11/05
Wireless Subsystem Data Transmission	Ryan	11/08	11/19
Map MyoWare inputs to Keystrokes	Sam	11/15	11/19



References

[1] Gaba, Jacob A., "Air Keyboard: Mid-Air Text Input Using Wearable EMG Sensors and a Predictive Text Model" (2016). *Dartmouth College Undergraduate Theses*. 114. https://digitalcommons.dartmouth.edu/senior_theses/114

[2] Tap Systems, Inc., “Tap Strap 2”. *Tapwithus.com.* https://www.tapwithus.com/product/tap-strap-2/

[3] C. Choi and J. Kim, "A Real-time EMG-based Assistive Computer Interface for the Upper Limb Disabled". *2007 IEEE 10th International Conference on Rehabilitation Robotics*, 2007, pp. 459-462, doi: 10.1109/ICORR.2007.4428465. https://ieeexplore.ieee.org/document/4428465

[4] Backyard Brains, “Experiment: Signal Classification”. *Backyardbrains.com.* https://backyardbrains.com/experiments/RobotHand

[5] Maciej Zajaczkowski, “Simple Dry Electrode EMG for Arduino”. *Instructables.com* https://www.instructables.com/Simple-Dry-Electrode-EMG-for-Arduino/

[6] Sylvain Colliard-Piraud, “Using an electromyogram technique to detect muscle activity”. *STMicroelectronics* https://www.st.com/resource/en/application_note/dm00356634-using-an-electromyogram-technique-to-detect-muscle-activity-stmicroelectronics.pdf

[7] M. Marani, G. G. Katul, W. K. Pan, and A. J. Parolari, “Intensity and frequency of extreme novel epidemics,” *Proc Natl Acad Sci USA*, vol. 118, no. 35, p. e2105482118, Aug. 2021, doi: 10.1073/pnas.2105482118.

Bonus Sneak Peak

Thank you

Questions?