

# Hands Free Li-fi based Multi - Door Automation

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## Advanced Mechatronics Term Project

ME-GY 6933



# COVID-19 Situation!

- Despite washing hands frequently, there is no way to avoid touching door handles to unlock/ open doors.
- Door handles are a potential vehicle of infection.
- As per recent studies, the virus is said to last the least on copper (up to 4 hours) whereas it lasted up to 2-3 days on plastic.
- The ability of the virus to linger for so long only underlines the importance of hand hygiene and cleaning of surfaces



**Coronavirus**

<https://signaturethings.com/brass-hardware-to-prevent-cvoid-19-lower-infection>

<https://www.bbc.com/future/article/20200317-covid-19-how-long-does-the-coronavirus-last-on-surfaces>



# What is our Project Motive?



**PLASTIC & STAINLESS STEEL  
– THE MAJOR CARRIERS**

# What is our Project Motive?



✕

🔍 hands free **door opener**

🔍 hands free **soap dispenser**

🔍 hands free **dog leash**

🔍 hands free

🔍 hands free **keychain**

🔍 hands free **door opener keychain**

🔍 hands free **crutch**

🔍 hands free **hand sanitizer dispenser**

🔍 hands free **umbrella**

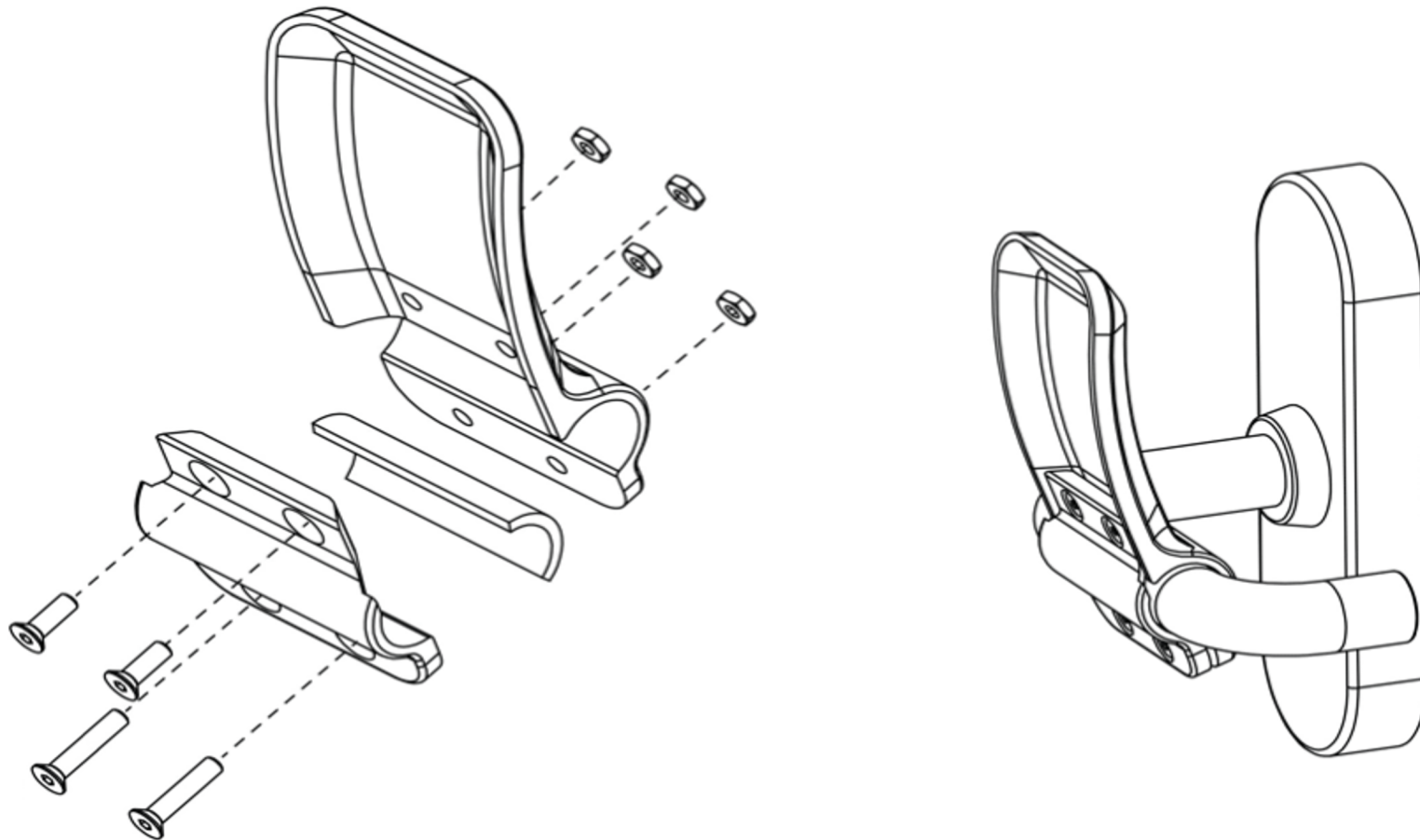
Google Search

I'm Feeling Lucky

[Report inappropriate predictions](#)

# Existing Solution – Hands-Free Door Handle!

Materialise designs a hands-free 3D-printed door opener for protection against COVID-19, and gives it for free.





# Materialise Solution



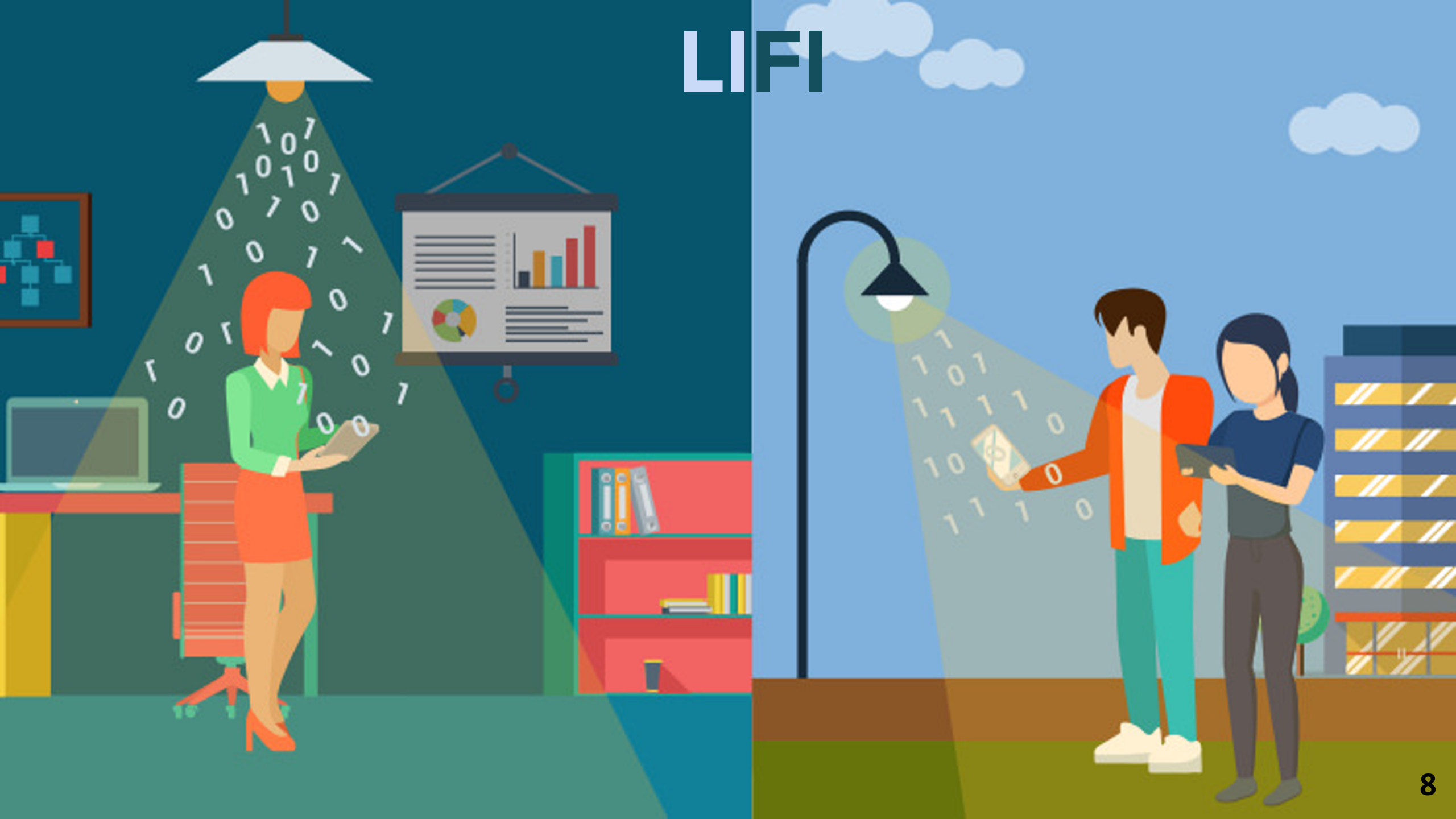
Our goal is to create a wearable mechatronic system that can automate multiple door actuation systems in hospitals and warehouses while maintaining security.

# Our Approach – Solution from Project 1!





# LIFI



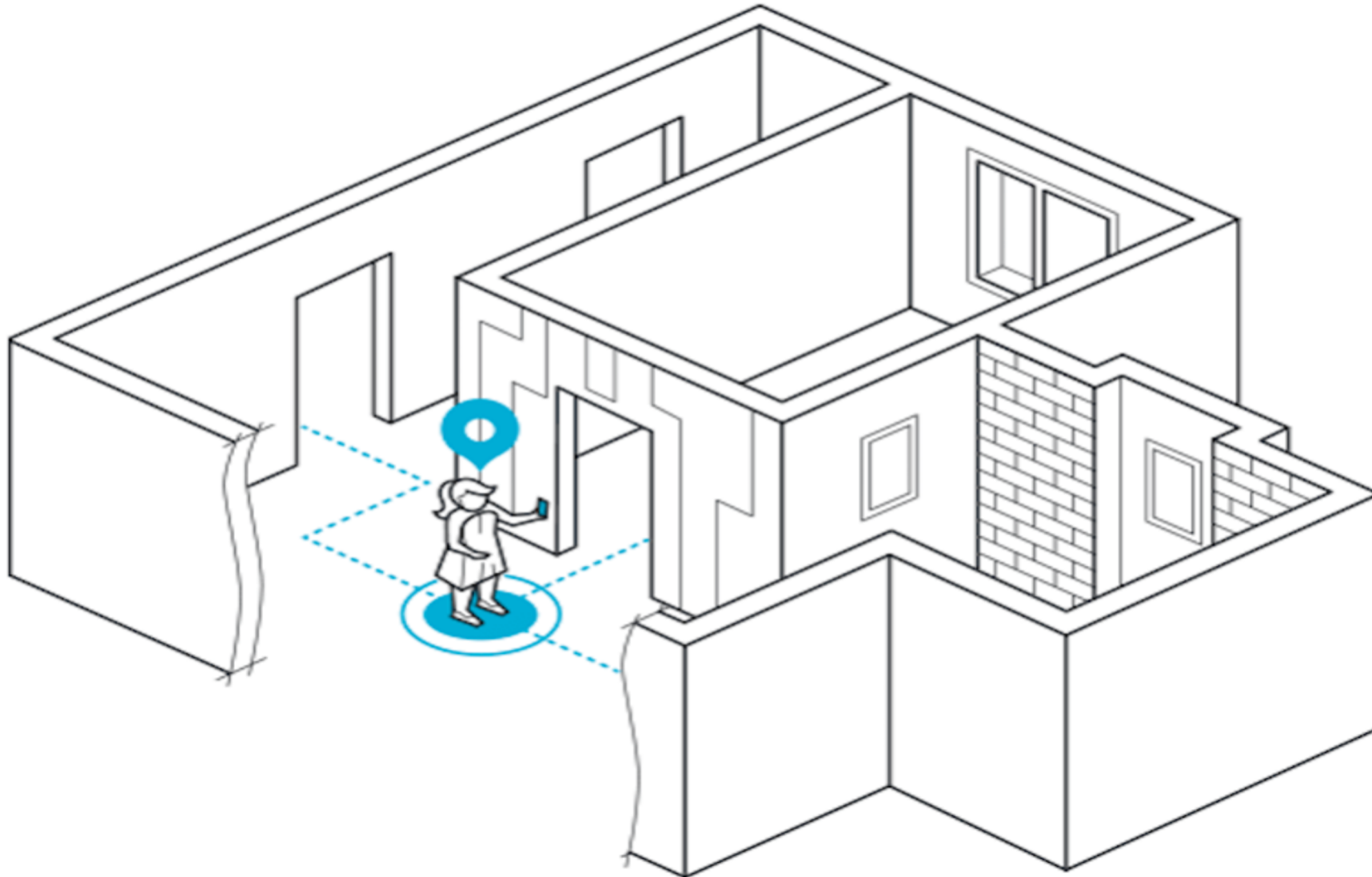
# What were the problems with Project 1?

- Can't open multiple doors with different passcodes. (i.e. In Hospitals)
- Had only 4 bits of data sequence. This means we can only unlock a maximum of 15 doors excluding '0000'.
- Time intervals between each bit was relatively high.
- The main issue is how do we make the smart band aware of a particular door. (i.e. Door Number)



# What is GPS based Indoor Localization?

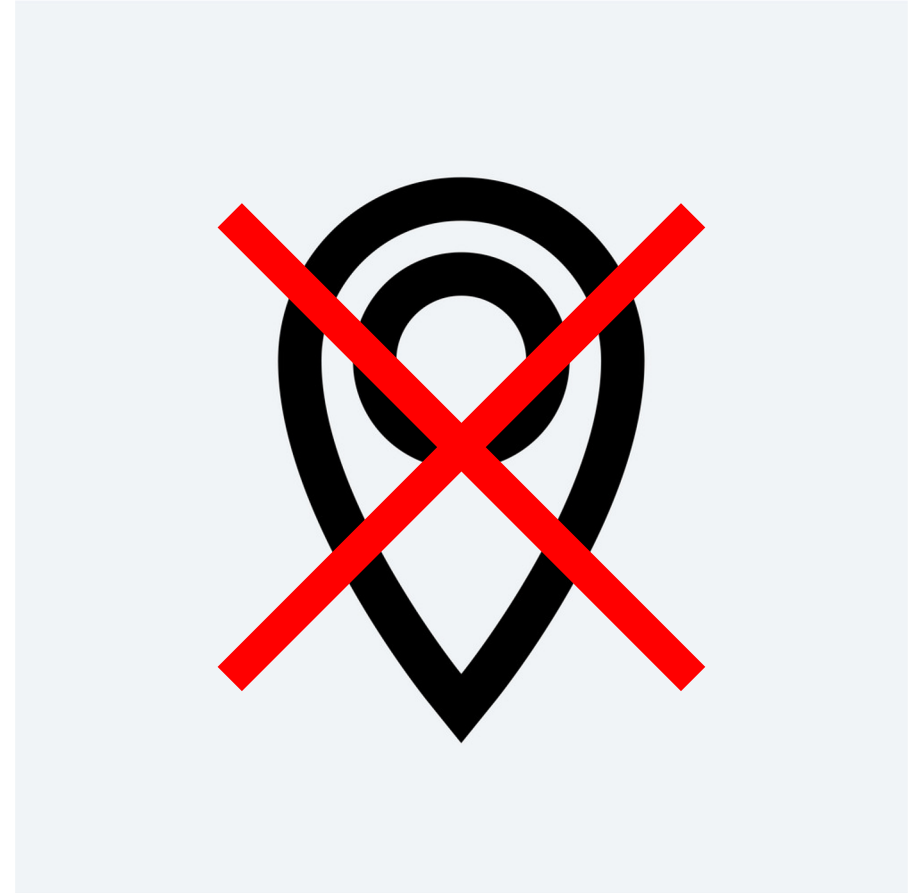
## INDOOR POSITIONING





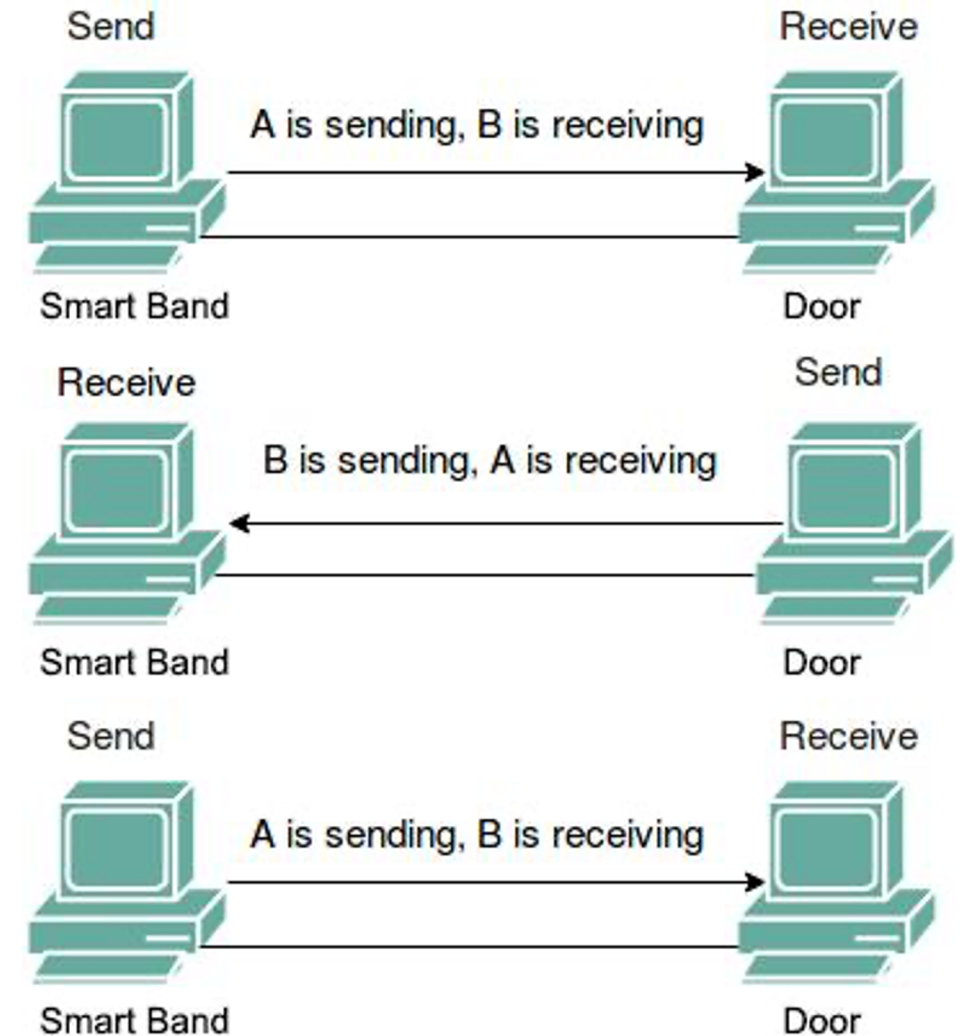
# So GPS? - No

- GPS have terrible indoor service.
- Their accuracy range is hardly usable for indoor applications.
- The United States government currently claims 4 meter RMS (7.8 meter 95% Confidence Interval) horizontal accuracy for civilian (SPS) GPS .
- Vertical accuracy is even worse.
- The height provided by GPS produces errors based on the surface of earth and sea level. (Accuracy + - 5m.)



# A much simpler solution!

- Make the door talk!
- Introduce another pair of LED and LDR.
- Similar to Half-duplex Asynchronous Communication.
- Three Stages:
  1. Smart Band Detection
  2. Door Number Recognition
  3. Generate Password Sequence



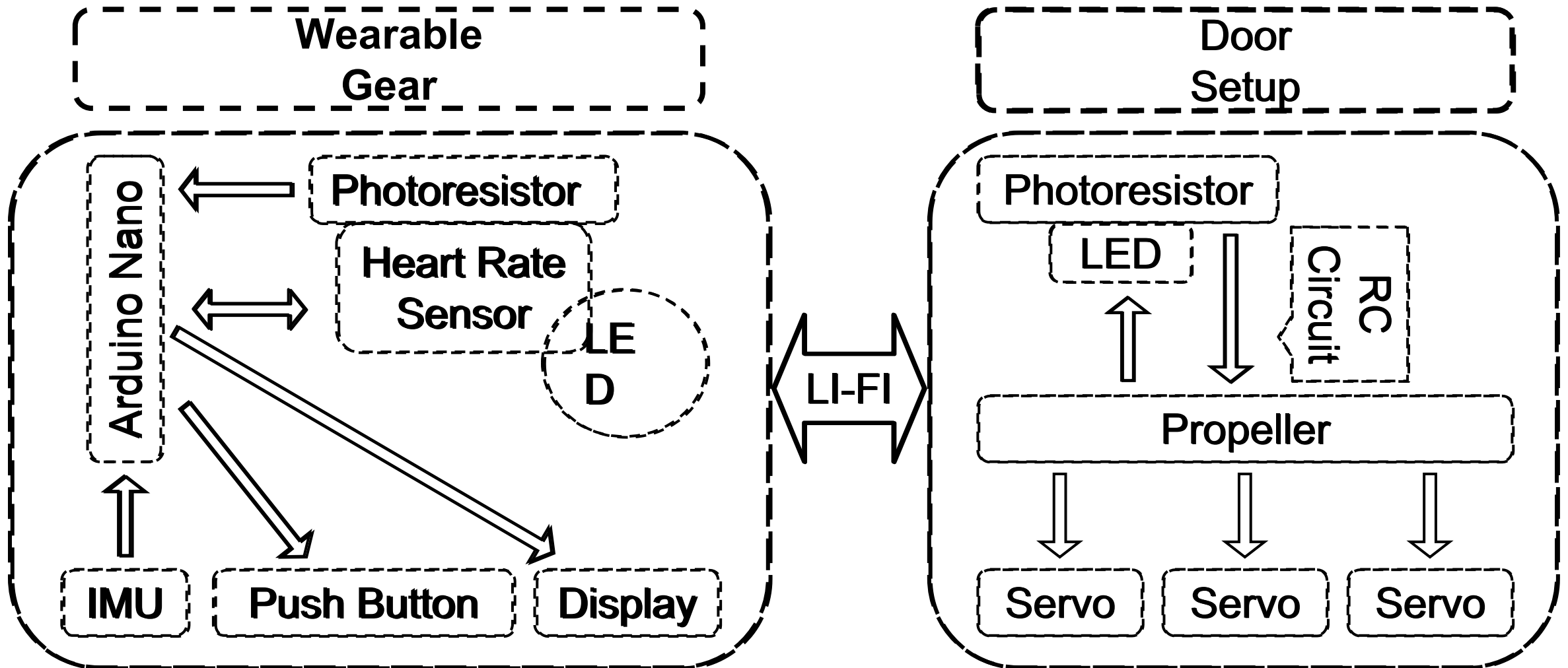
# WHAT'S NEW?



- Two way Faster communication. The time between each bit sequence is as low as 10 microseconds.
- Greater security in passwords. 10 bit data sequence gives us the possibility to unlock 255 doors (excluding '00000000').
- Gesture Detection. We are going completely hands free to trigger the start sequence.



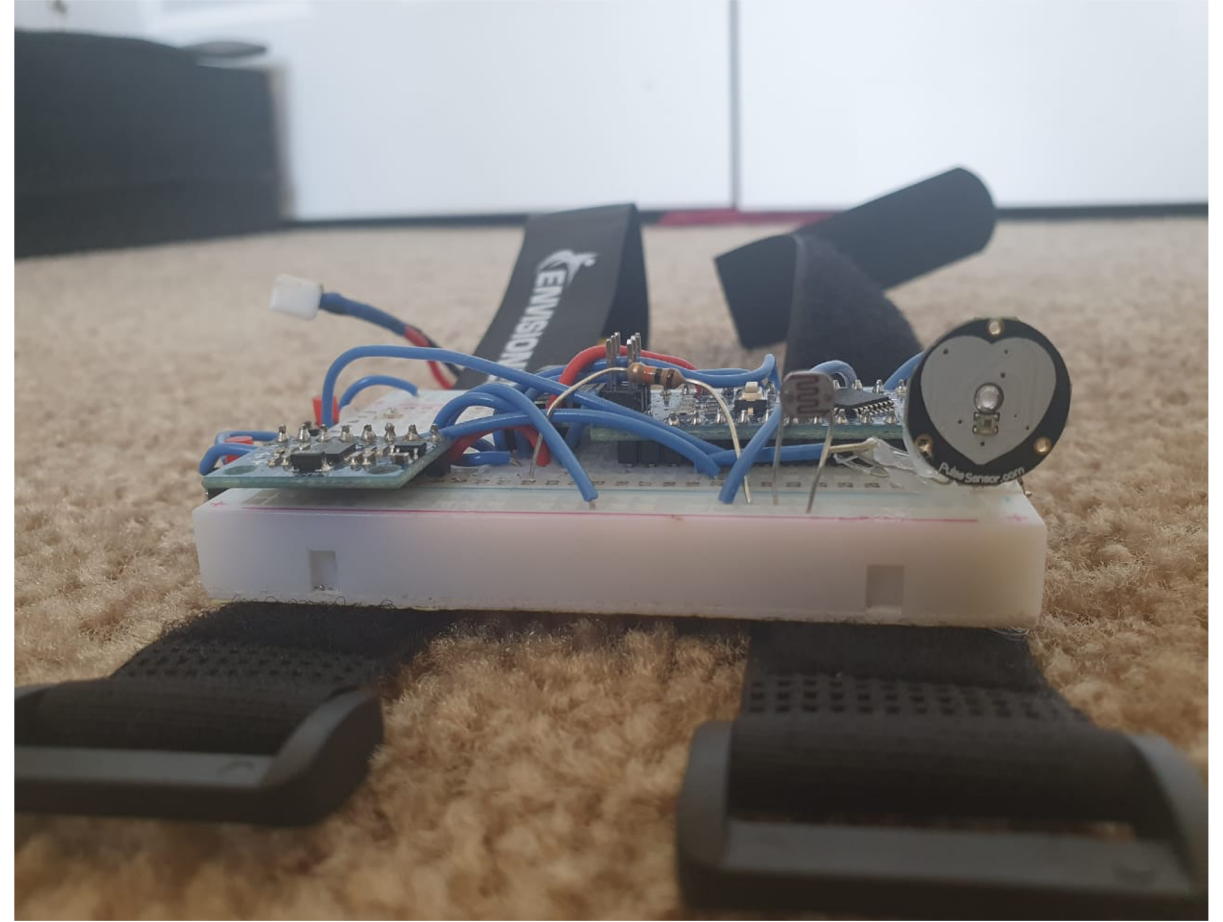
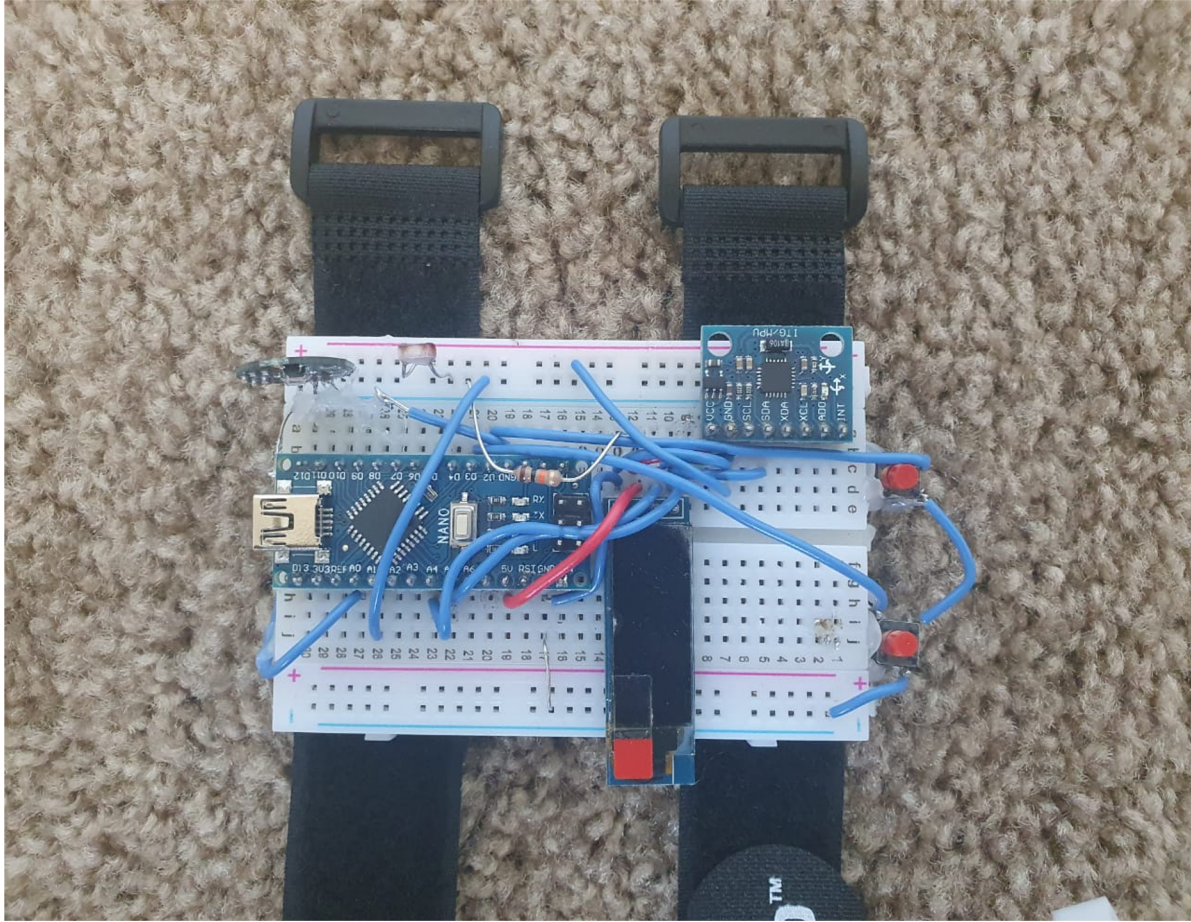
# Design Schematics



# What made us choose our Microcontrollers?

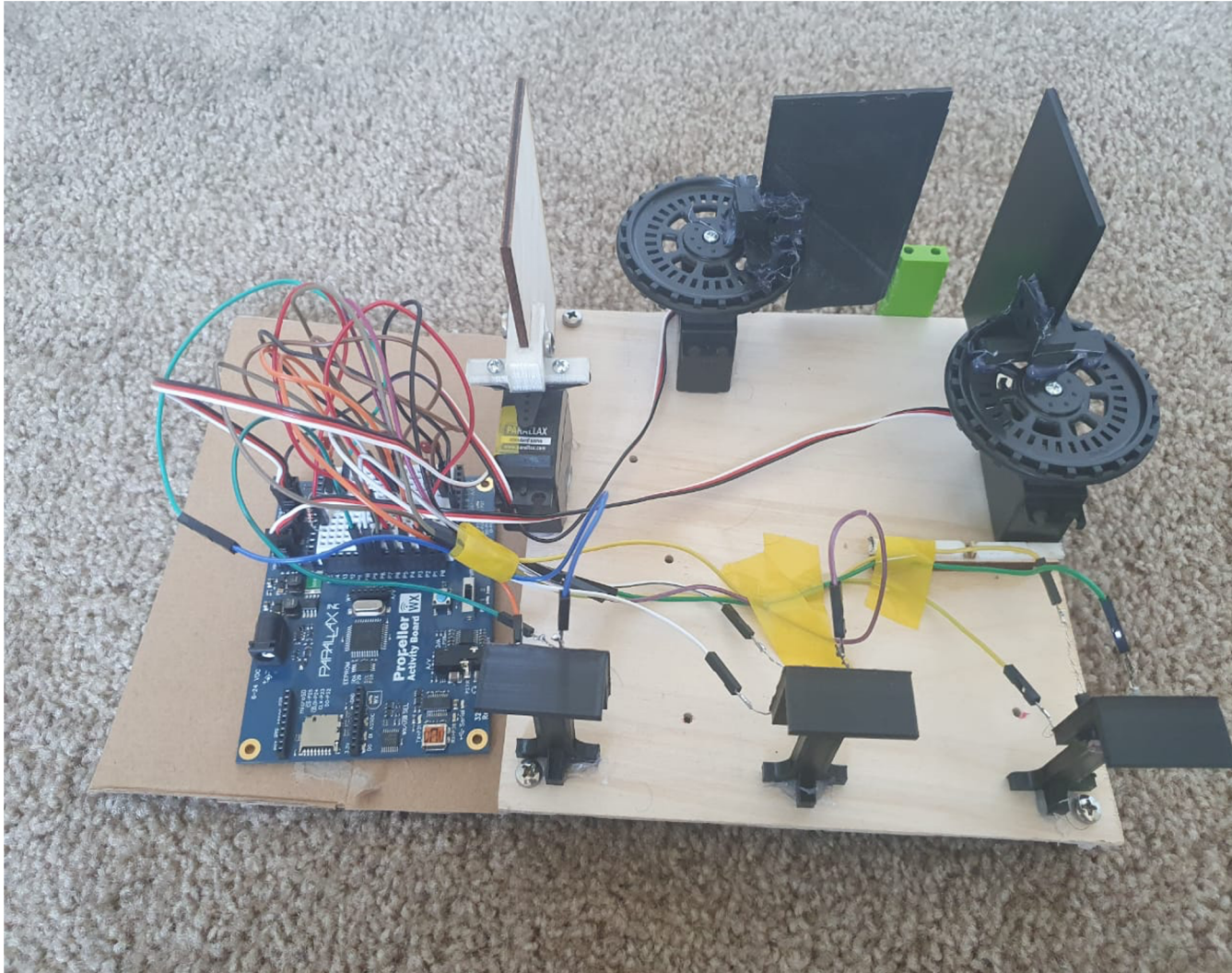
<b>Smart Band (Arduino Nano)</b>	<b>Door Automation System (Propeller Activity WX)</b>
Small form factor	Multi Cog Functionality
Cheaper	On-board ADC, RC Time command
On-board ADC	Logic Levels stay at 0V and 5V.

# Wearable Band Prototype



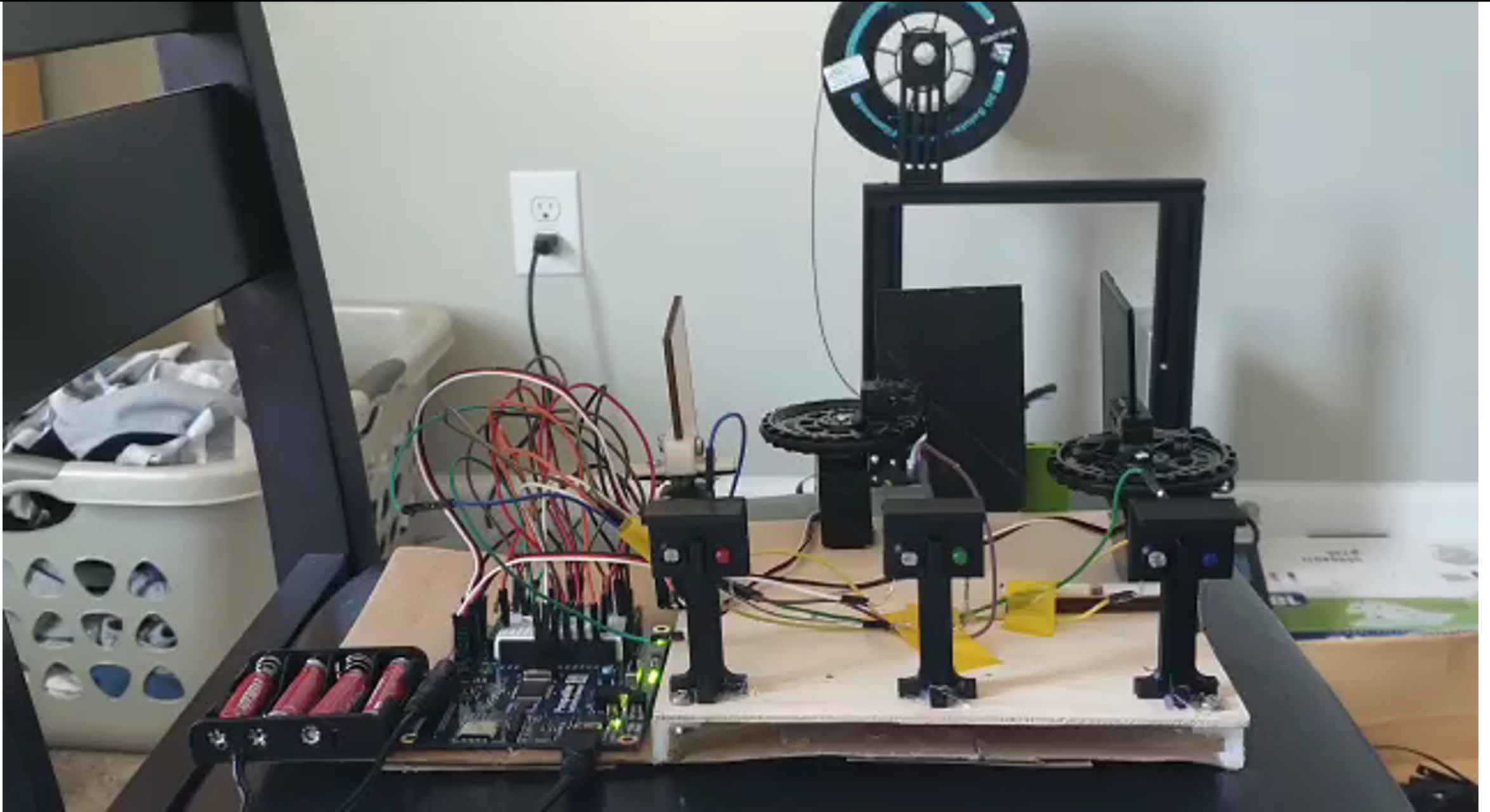


# Door Automation System Prototype

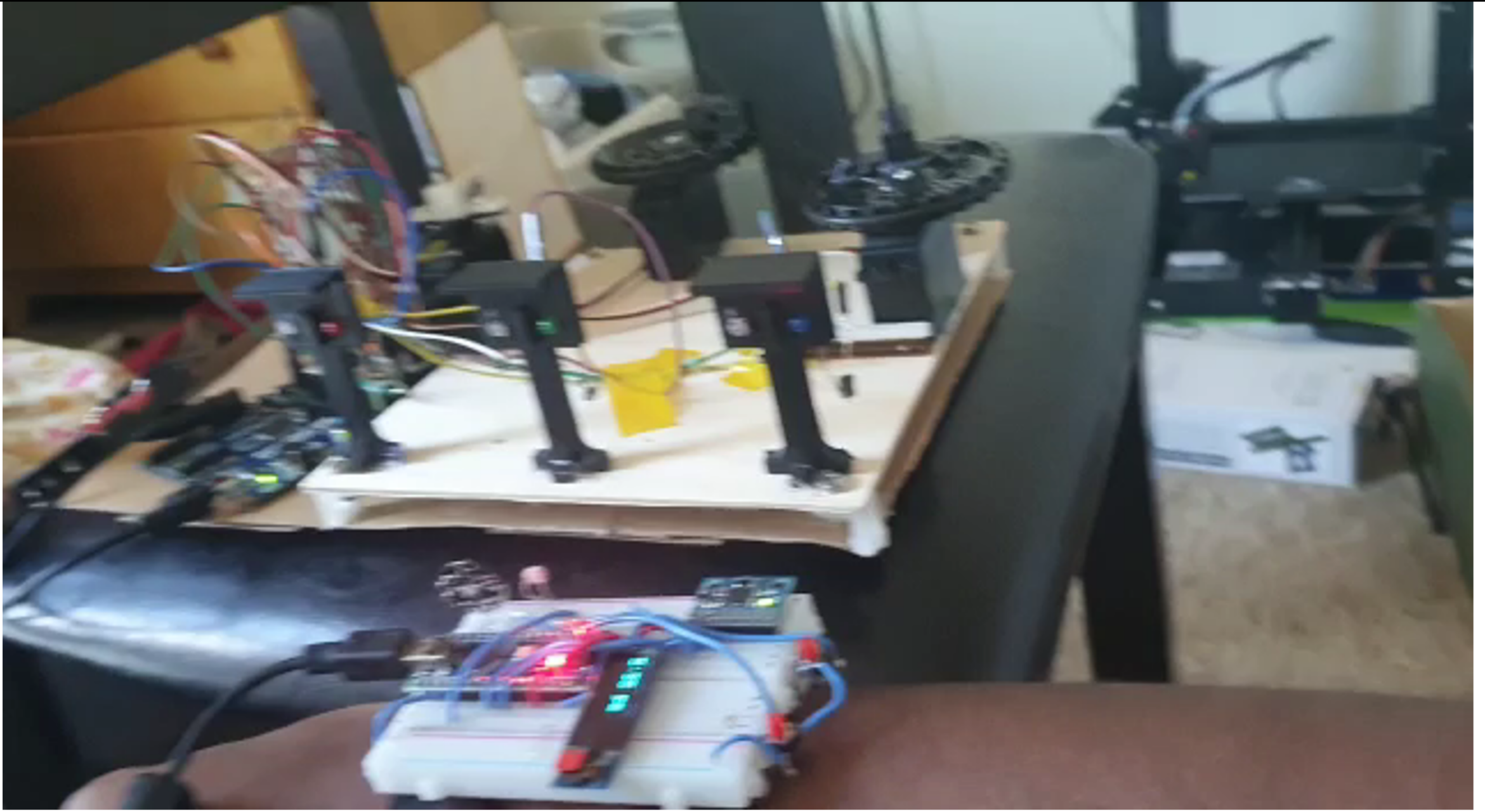




# Working Prototype

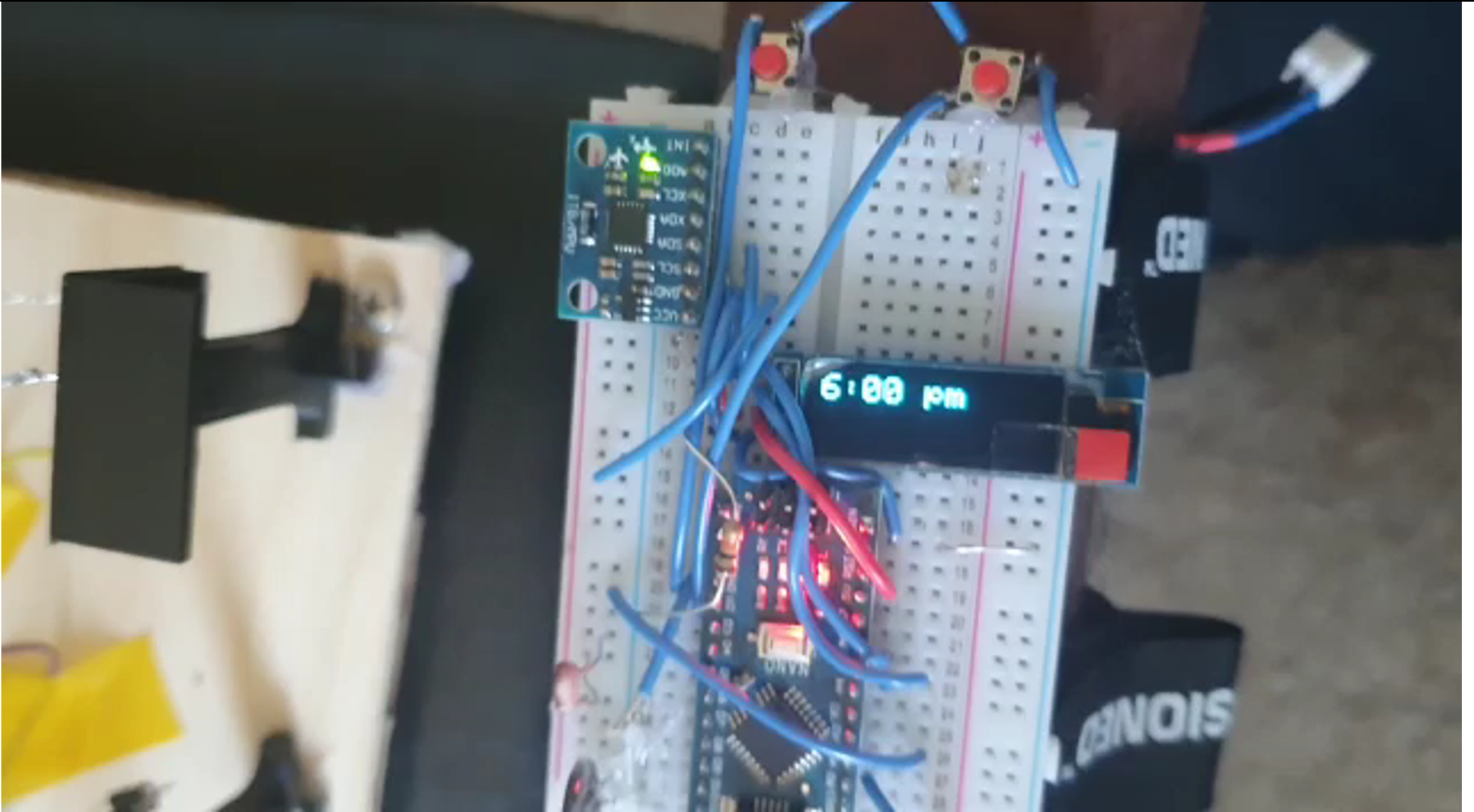


# Working Prototype

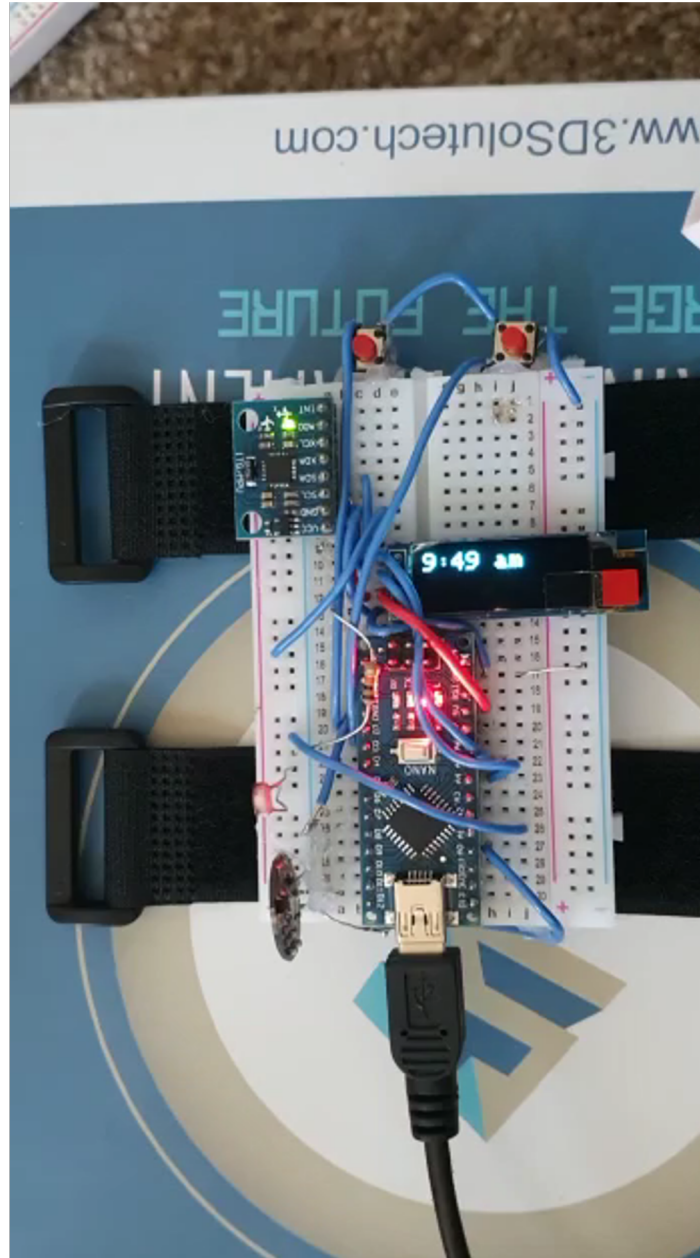




# Working Prototype



# Working Prototype





# What's our next aim?

- Battery Level Indicator.
- Haptic feedback, when the push buttons are pressed.
- Using the Display as a source of light rather than a separate LED in order to simplify the design and reduce the overall size of the watch.
- Use the Nano IoT's on board IMU sensory data to trigger the LED, for a very compact design.



# Thank You!

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