

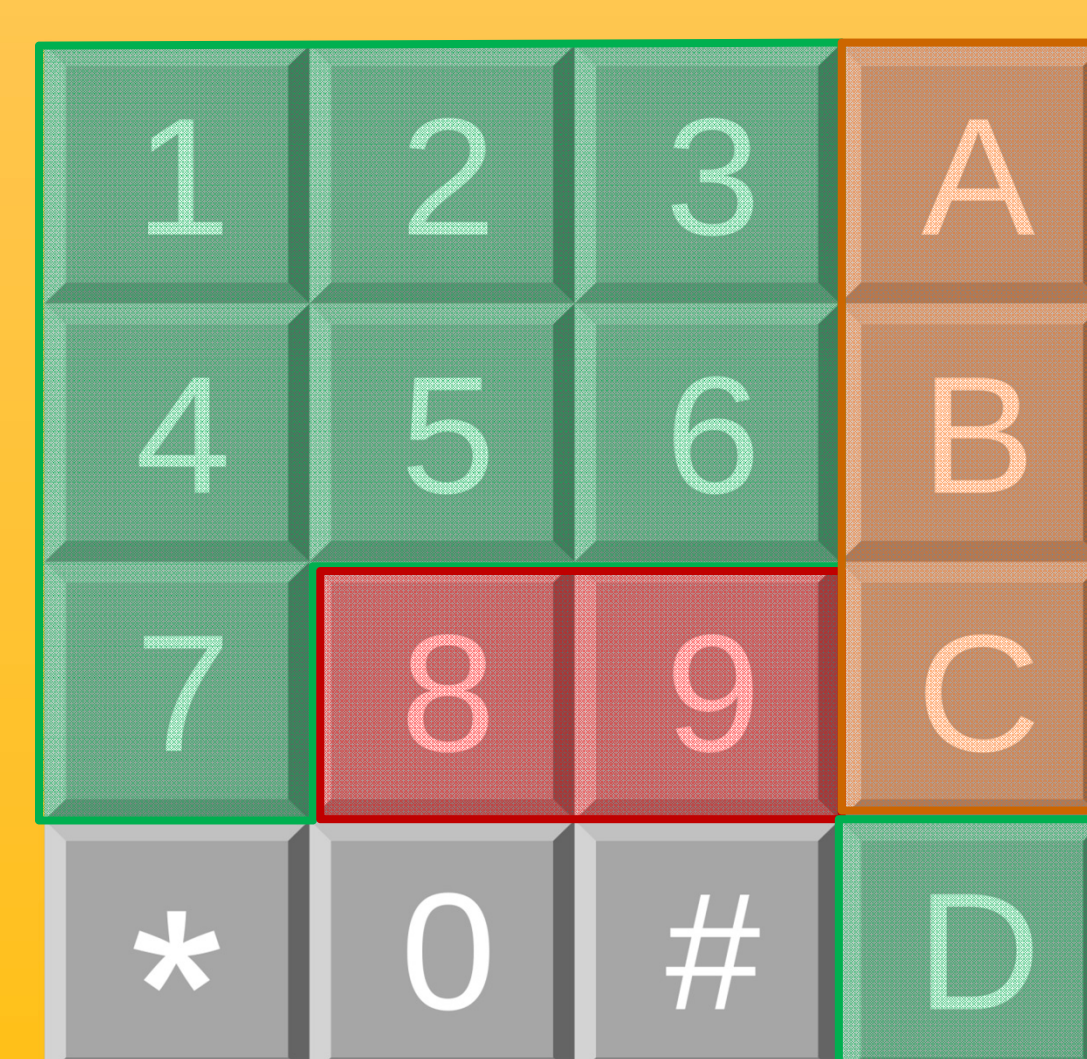
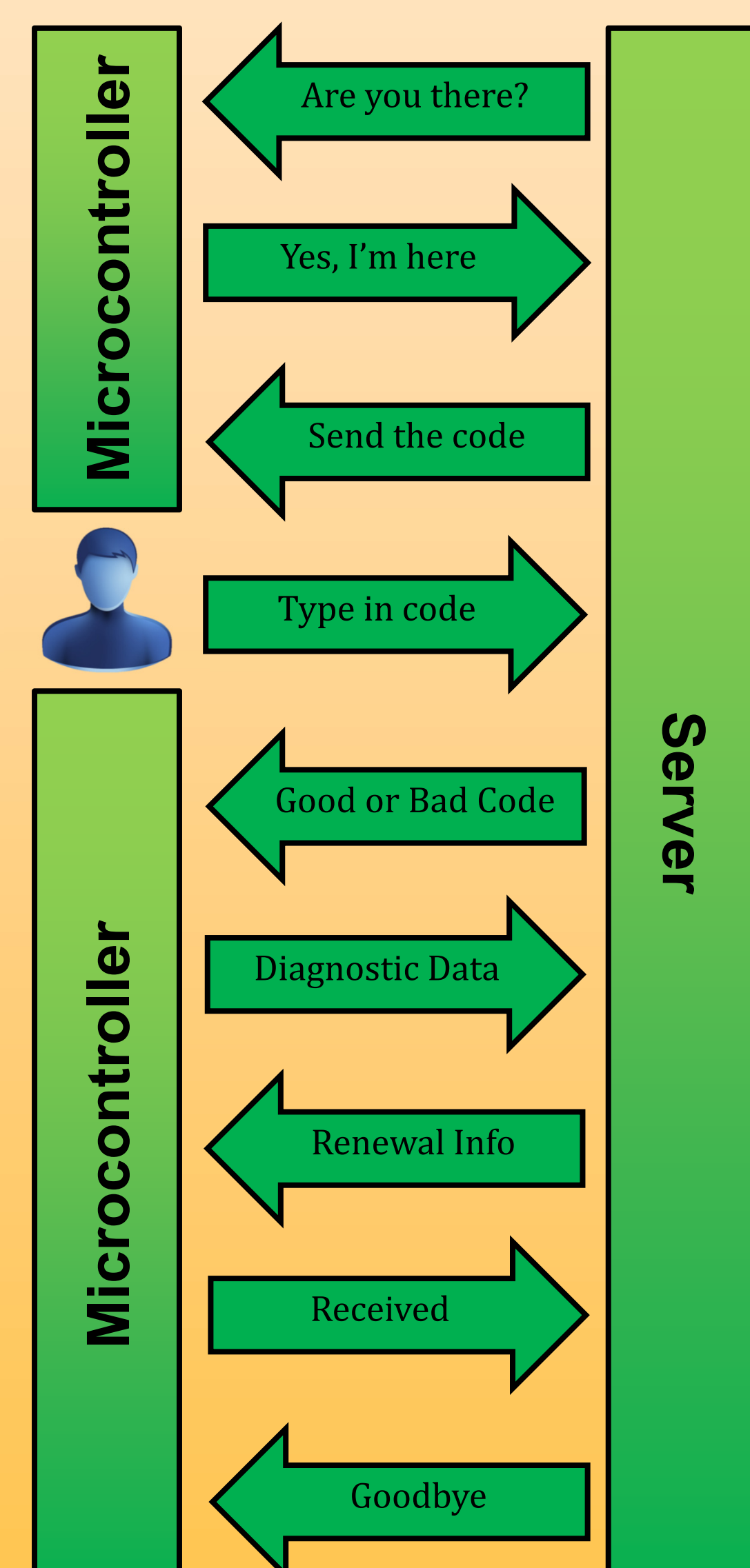
Rejuvalight

Subscription-Based Solar Powered Light & Charger

Unite-to-Light (UTL) is a non-profit organization with the goal to provide portable solar lights to the most underdeveloped regions of the world. Cellphone use in these regions has rapidly increased while power distribution remains largely unreliable. As a result, many are turning to mass charging stations where users pay a costly fee to hook up their cell phones to gas generators. UTL is currently developing a new light with a USB port to charge small electronic devices such as cell phones. This gives users the freedom to charge their electronics anywhere with sunlight and without having to pay a third-party.

What is Rejuvalight? Why is it needed?

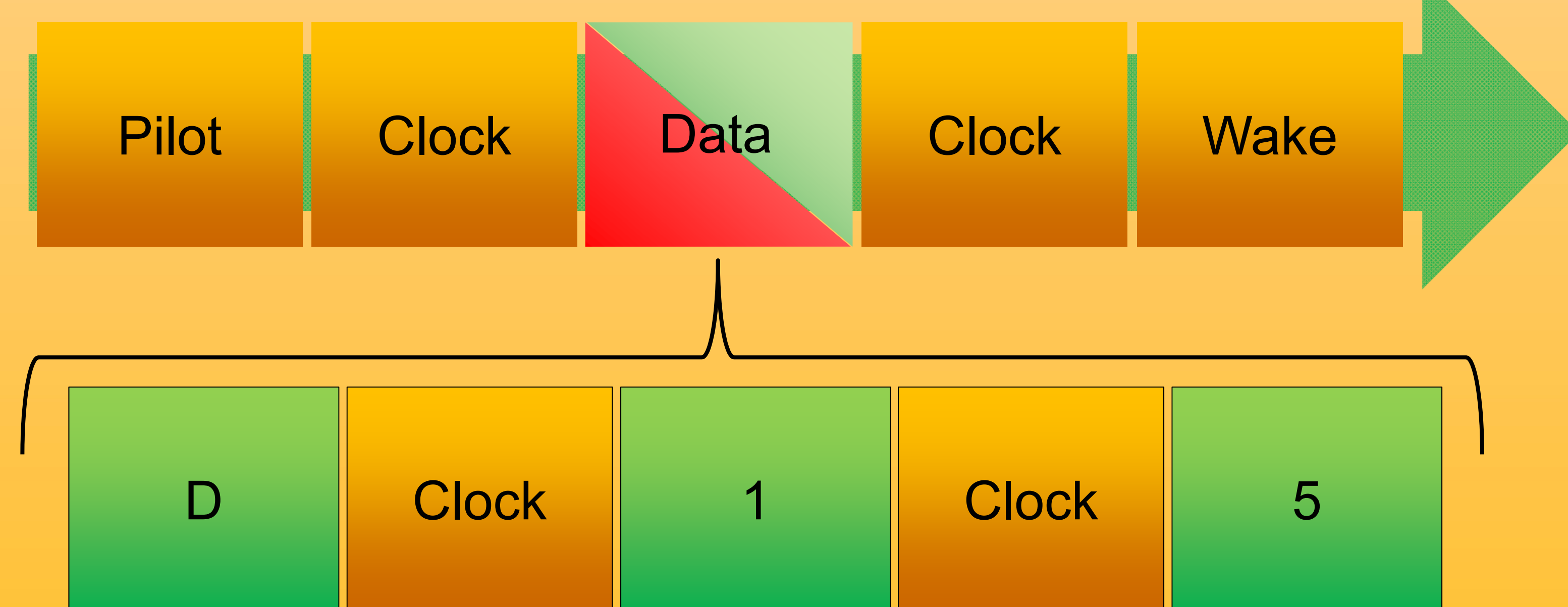
Adding a USB port introduces considerable product cost; larger batteries and solar panels are needed to sufficiently power these external devices. The upfront cost to those with low income will prevent this device from getting into the hands of those who need it the most. The Rejuvalight team has addressed these needs by producing our own USB enabled version with a cellular-based subscription service; specifically, we have replaced the PCB with our own design tailored for charging electronics and cellular communication. The user will pay a small fee periodically (e.g. weekly) to activate the full use of the light and charging port. After time has expired, the device will operate in a reduced functionality mode until the user renews the Rejuvalight.



How does the renewal process work?

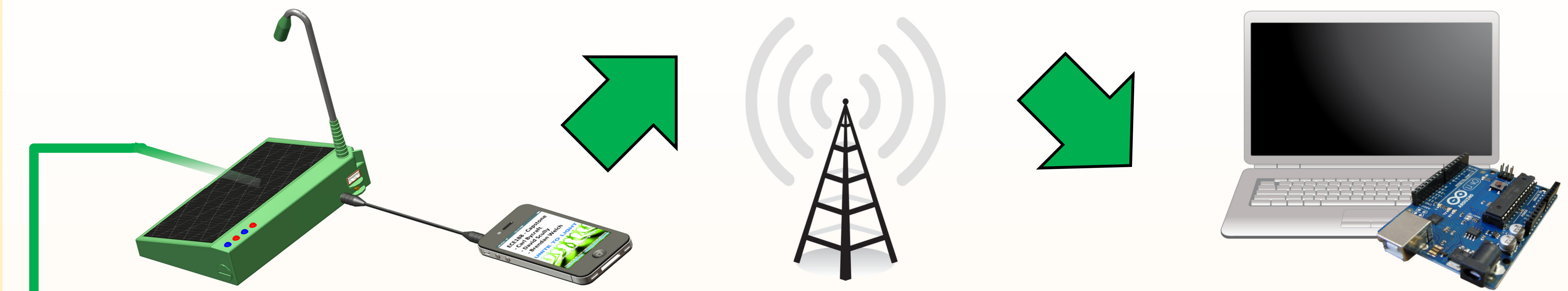
To maximize compatibility with cellphones, renewal is done by connecting a 3.5mm audio cable between the phone and Rejuvalight. Effective communication of information through cellphone networks is achieved using the Dual Tone Multiple Frequency (DTMF) standard. Sixteen dual tone pairs represent symbols in the protocol — twelve are the familiar keypad tones.

- Proven method: transmit/receive ICs available
- Asynchronous communication (encoded clock)
- Each tone represents a 3-bit binary number
- Robust to channel noise in the telecommunication network



Green: Data tones. Each represents a 3-bit binary number.
Orange: Stream synchronization. Clock, pilot, and wake signals.
Red: Special tones. For transaction errors and confirmations.
Grey: Reserved for future use.

How does our demonstration work?

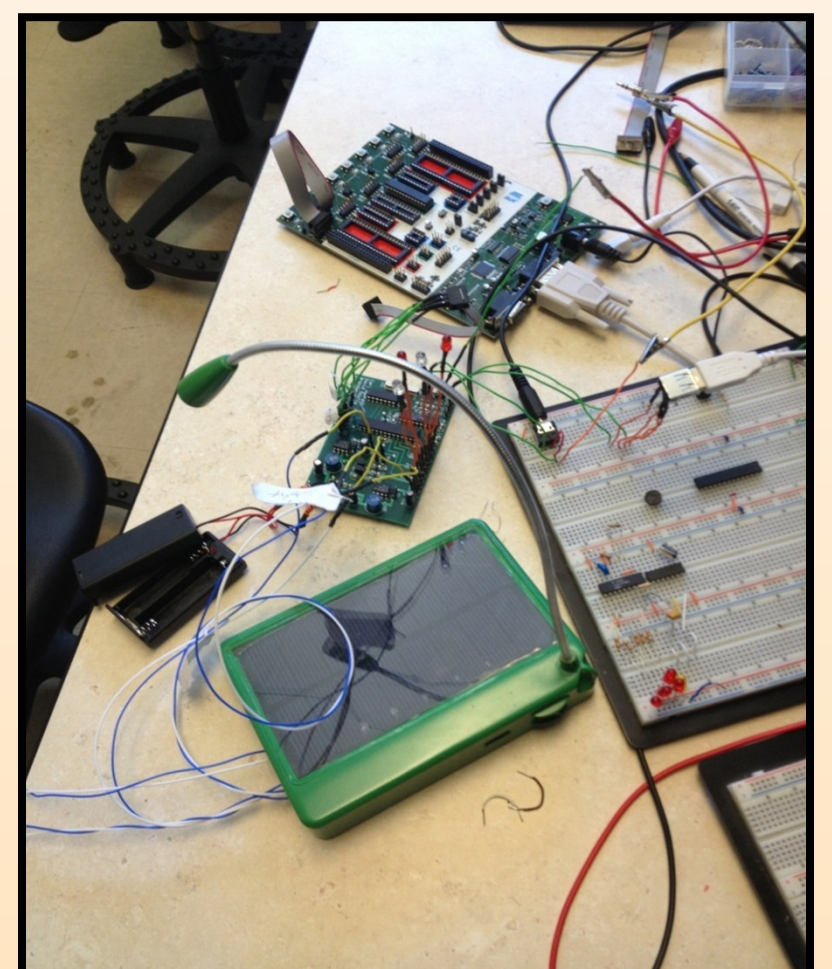
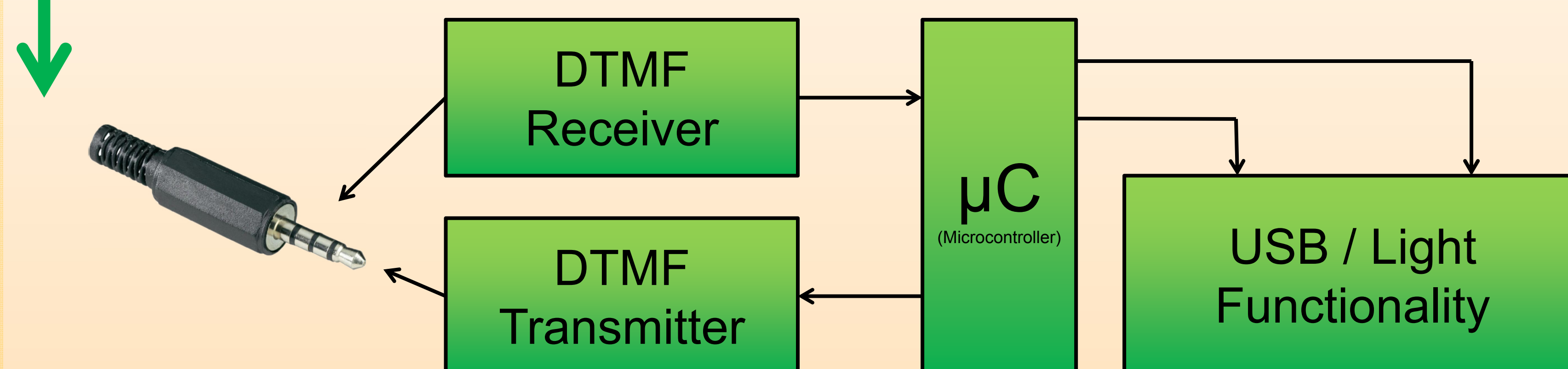


Client Features

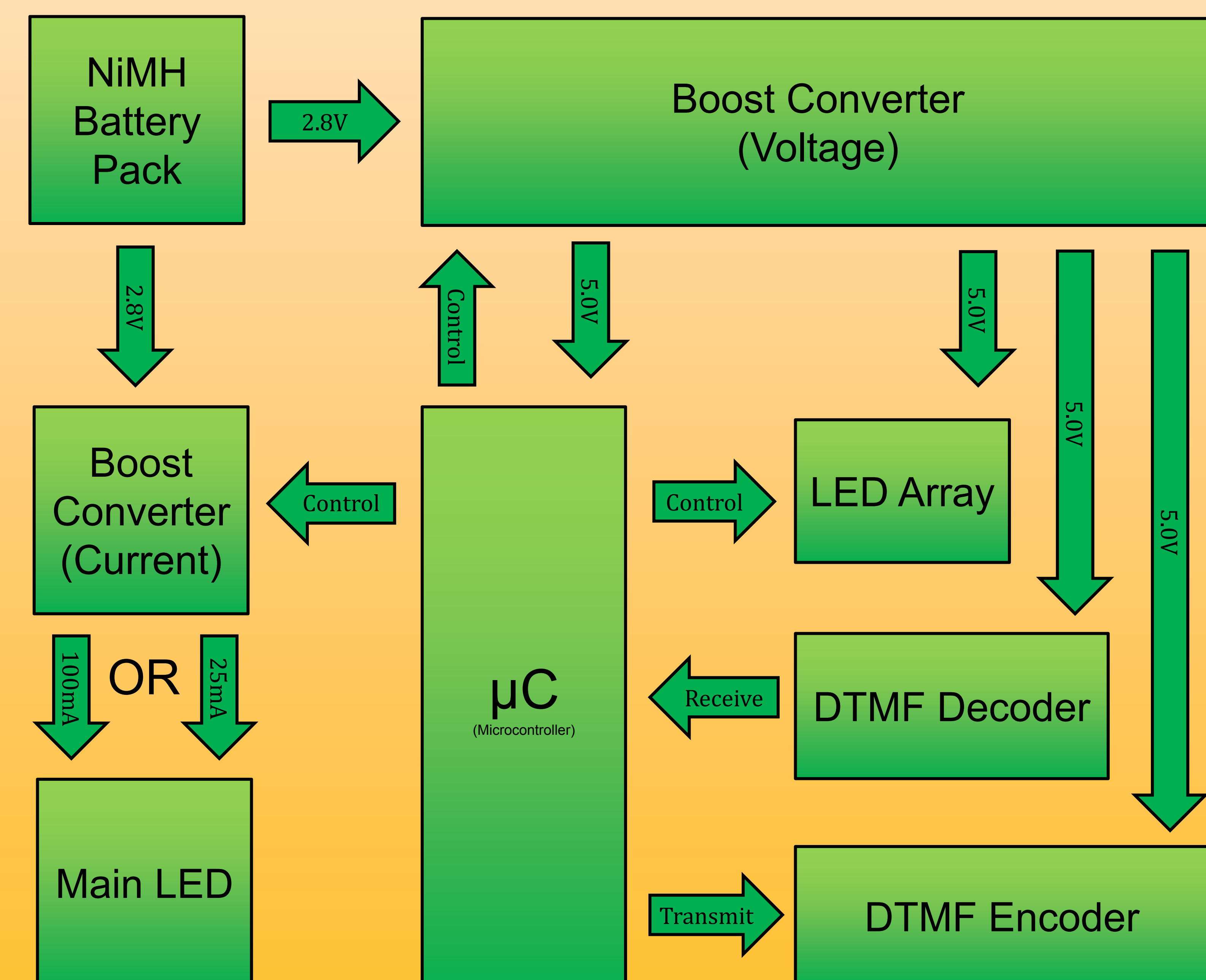
- 5V USB standard charging
- Multiple brightness settings
- Reduced feature-set when not renewed
- Automated renewal process via DTMF signaling
- LED indicators for low-battery and subscription status

Server Operation

- Communicates renewal information
- Receives and processes diagnostic info
- Replay attack prevention (unique transaction each time to prevent server emulation)
- Phone call handling via Google Voice



What is on the circuit board?



Microcontroller

- Transmits and receives digital signals from the DTMF decoder and encoder
- Keeps track of device diagnostics data
- Provides feedback to the user via LED array
- Arbiter of operational status for the Pay-As-You-Go feature

Boost Converter

- Efficiently converts the low voltage battery pack to acceptable levels
- Can regulate voltage or current depending on sense node

LED Array

- Low battery
- Good transaction
- Bad transaction
- Warning to renew

DTMF Decoder

- Receives and filters DTMF tones and outputs digital bits

DTMF Encoder

- Receives a serial input and generates a DTMF tone on clock edge

NiMH Batter Pack

- Two cheap, rechargeable, and replaceable AA batteries

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