



PROJECT MULTIPURPOSE KEYCHAIN

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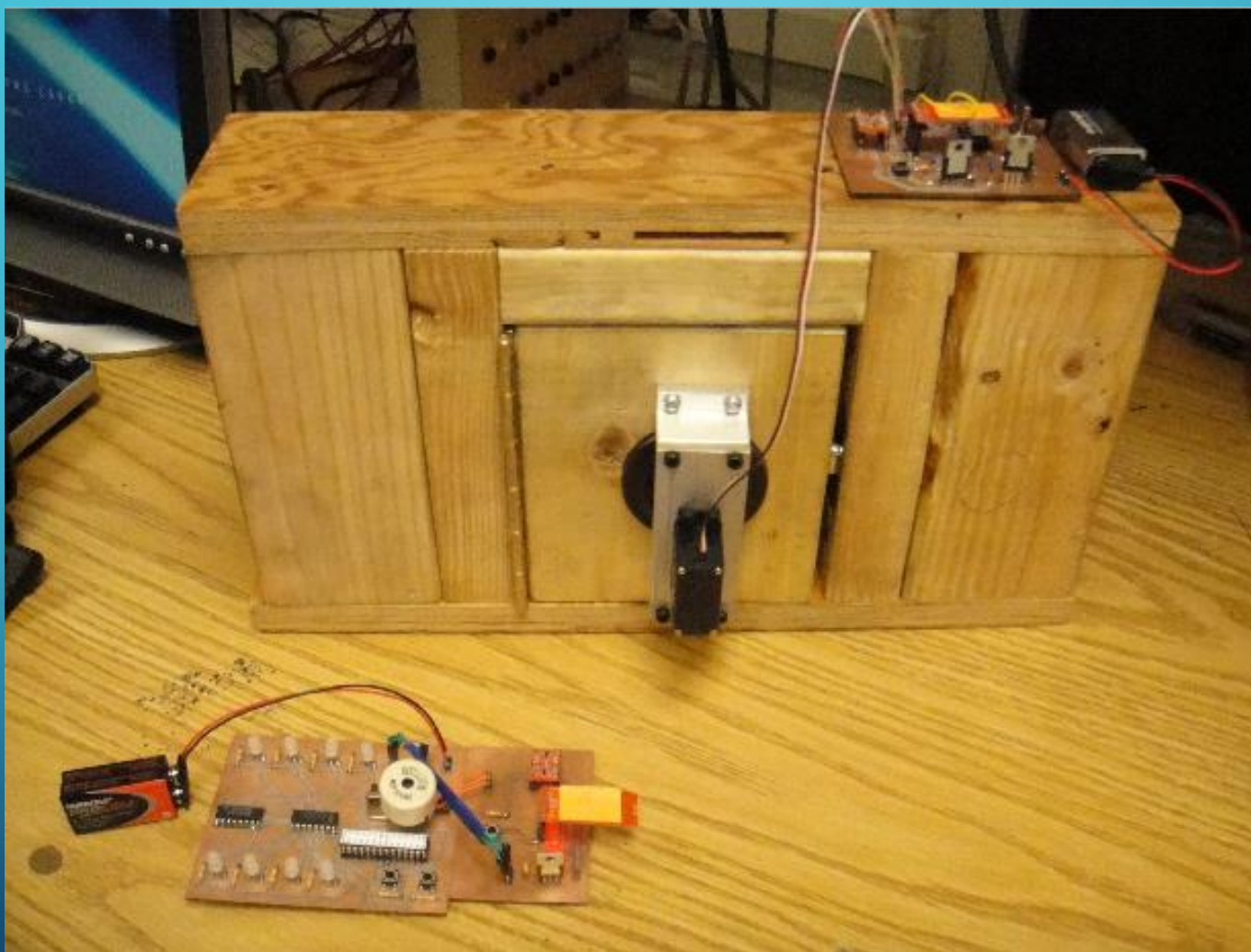
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INTRODUCTION

- Target mechanical locks
- An electronic key chain with a device for locks
- Functionalities
 - Up-to-date lock status check
 - Indicate right key to specific lock
 - Buzzer for locating key chain
 - Remotely lock/unlock

FEATURES

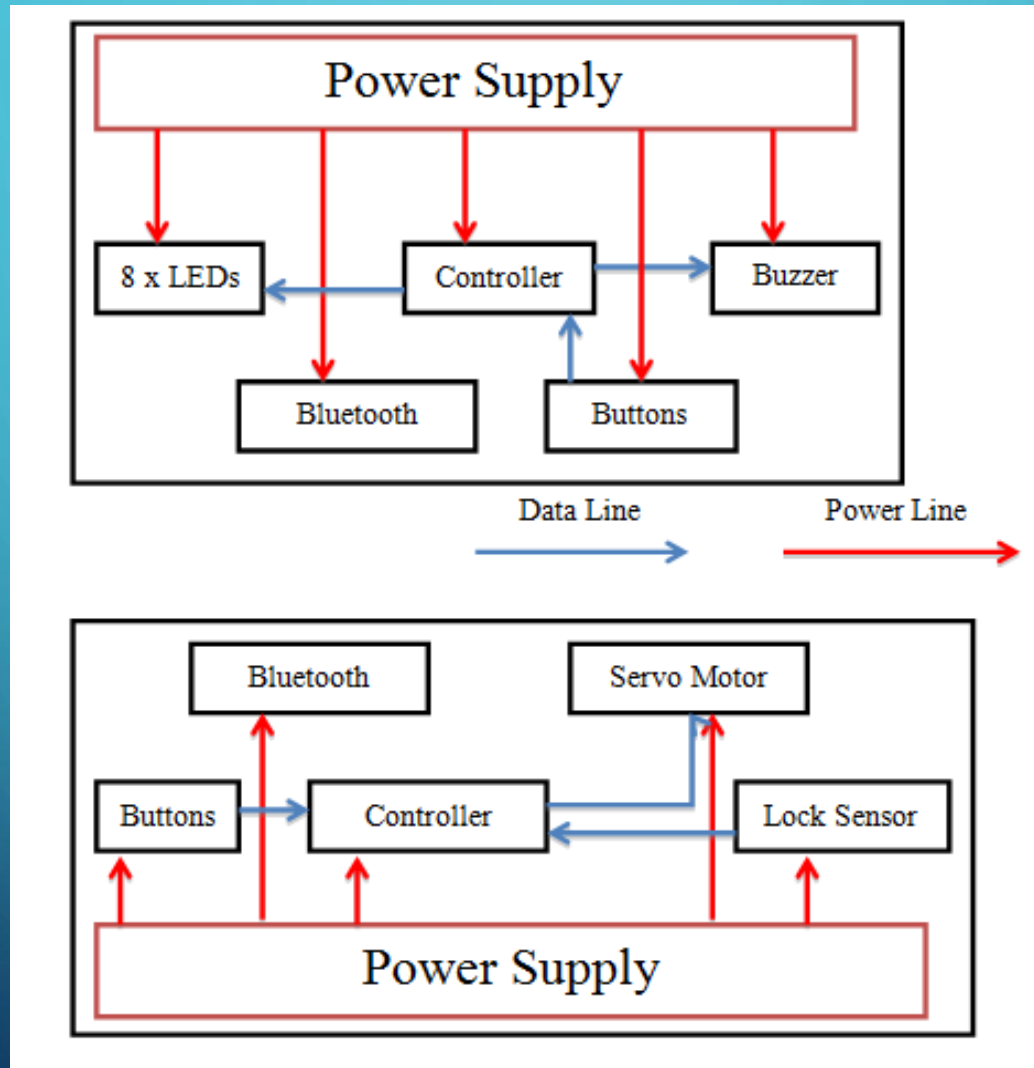
- LED display interface
- Bluetooth communication
- Holds 8 keys (Expandable)
- Button controlled
- Traceable with installed buzzer
- Built-in sensor (Lock Side)



SYSTEM OVERVIEW

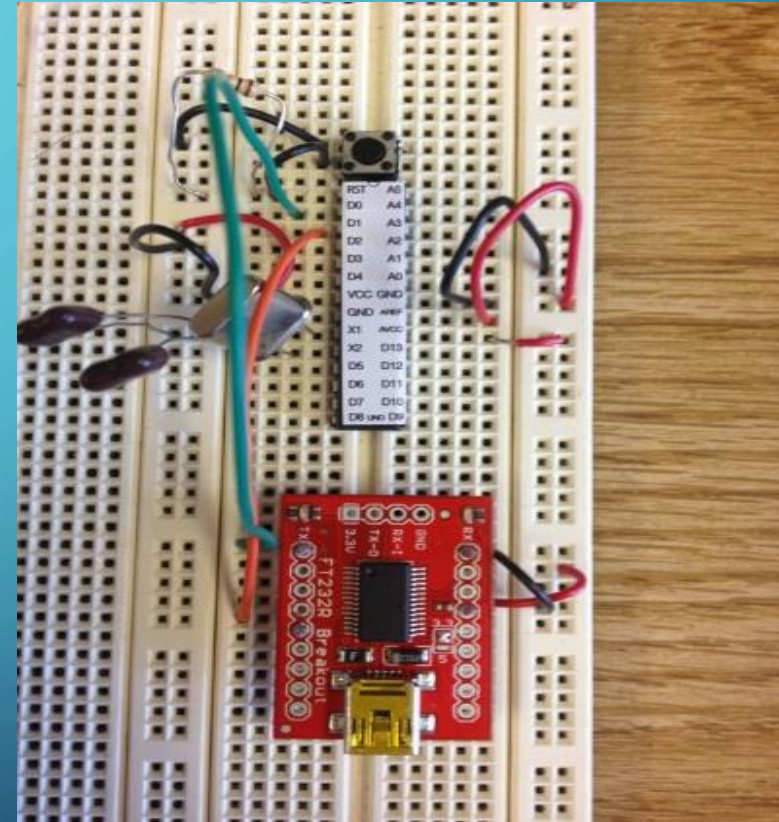
- Hardware:
 - Power Supply
 - Microcontroller Unit
 - Bluetooth
 - LED, Buzzer
 - Built-in sensor and motor (Lock Side)
- Software:
 - Arduino Programming Environment
 - Configurable with PC

BLOCK DIAGRAM



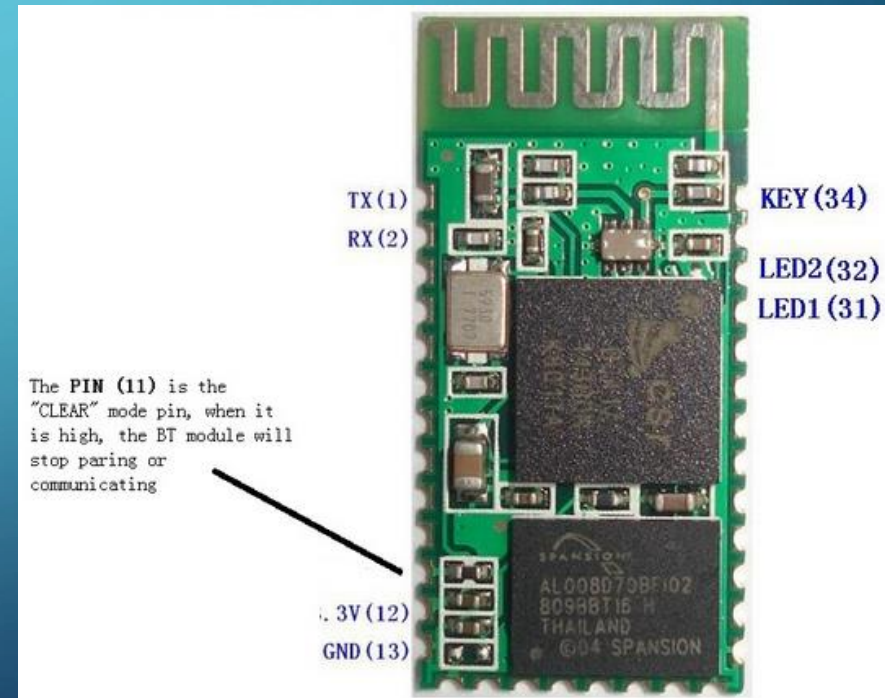
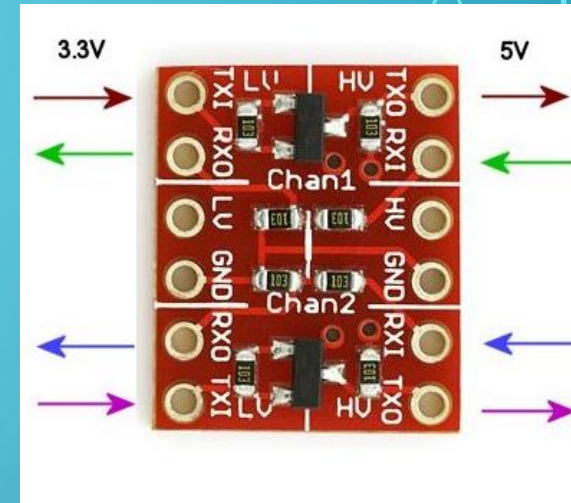
HARDWARE

- Power Supply
 - 9V alkaline battery
 - 5V and 3.3V voltage regulator
- Microcontroller Unit
 - Atmel ATmega328 with Arduino UNO bootloader
 - FTDI breakout board for programming
- Addressable Latch



HARDWARE

- Bluetooth
 - HC-05 Bluetooth transceiver module
 - Master/Slave
 - Configuration using AT command in Putty
 - FTDI breakout board
 - Logic level converter
 - Pin 11 for enabling/disabling connection

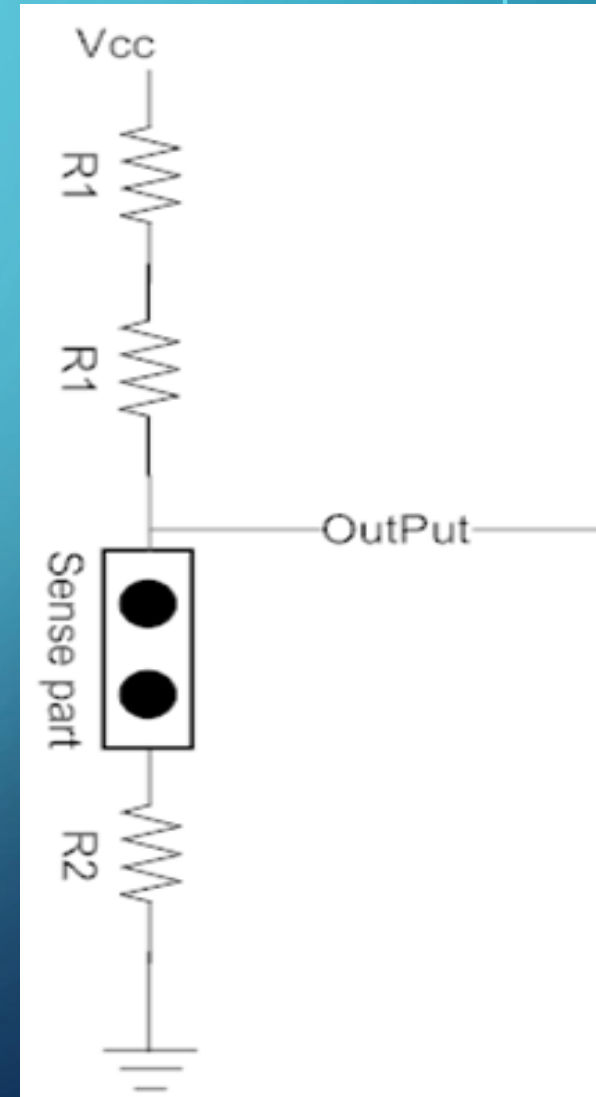


AT COMMAND

Purpose	Command
Verify Connection	AT
Set Name	AT+Name = <name>
Set Role	AT+Role = 1(Master)/0(Slave)
Set Pairing Code	AT+PSWD = <password>
Pairing Options	AT+CMODE = 1(Auto)/0(Last Address)

HARDWARE

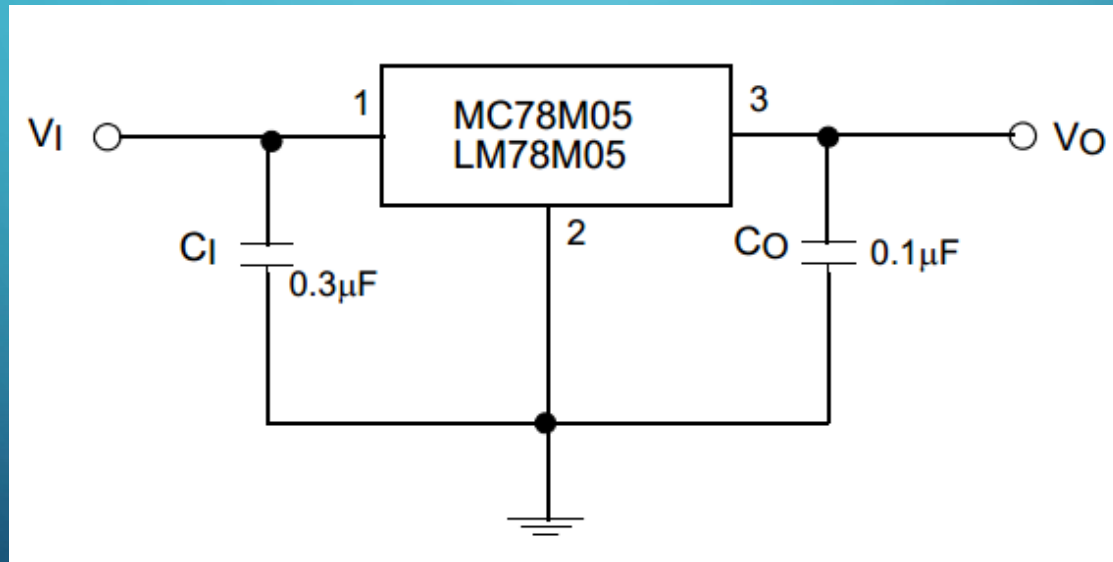
- Servo Motor
 - Parallax continuous rotation servo
 - Control rotation by speed and time
- Sensor
 - Voltage divider circuit
 - Output is high when connected and low when disconnected
- LED
 - Bicolor LEDs with common cathode
 - Red (locked)/ Green (unlocked)



The diagram shows a microcontroller (IC3, MEGA8-P) interfaced with an ABS sensor (G1) and an ABS solenoid (S1). The microcontroller is connected to the sensor via an I2C interface (PC0-PC5) and to the solenoid via a relay (S1). The circuit includes various passive components like resistors (R1-R6), capacitors (C1-C6), and jumpers (JP1-JP5).

POWER SUPPLY (REQUIREMENTS)

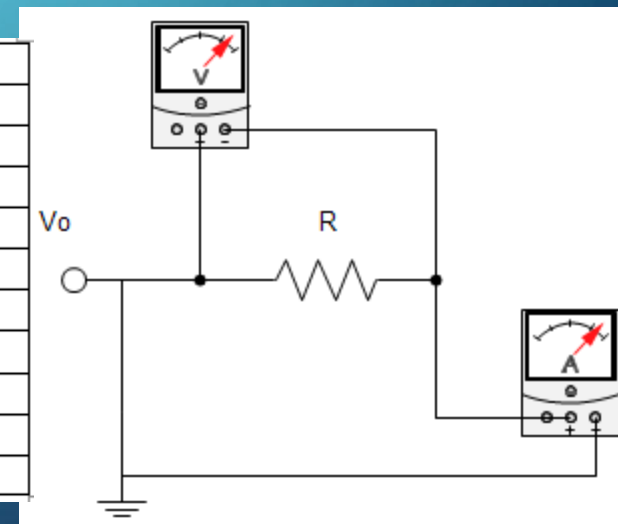
- Supply steady 3.3V and 5V voltage with various current output



POWER SUPPLY (VERIFICATIONS)

- Using different resistor values to create corresponding current output and measure the voltage output from the voltage regulators.

R, Resistance (Ω)	I, Current Reading (mA)	V, Voltage Reading (V)
250	19.88	5.03
125	39.96	5.02
83	60.31	5.02
63	79.75	5.02
50	101.03	5.02
42	119.62	5.04
36	141.10	5.01
31	160.84	5.06
28	179.23	5.02
25	201.50	5.02



MICROCONTROLLER UNIT (REQUIREMENTS)

- Correctly detects button presses
 - Debouncing
- Able to display correct information about locks.

MICROCONTROLLER UNIT (VERIFICATIONS)

- Debouncing is not necessary because of the time delay after button presses for BT connection.
- Test results involving MCU, addressable latches and LEDs:

Stored Combination	Verified
LLLLUUUU	Yes
UUUULLLL	Yes
LLUULLLU	Yes
UULLLUUL	Yes
LULULULU	Yes
ULULULUL	Yes
LLUUUUUL	Yes
UULLLLLU	Yes
LUUUUUUL	Yes
ULLLLLLU	Yes

BLUETOOTH (REQUIREMENTS)

- Reliably send and receive data with various time intervals ($>0.5s$)
- Reliably send and receive data within reasonable distance ($<20m$)

BLUETOOTH (VERIFICATIONS)

- Test involving two MCUs each connected with a Bluetooth module

Results:

- Using logic level converter
- time between sending and receiving is about 0.5ms



BLUETOOTH (VERIFICATIONS)

- Test results with various distance and time intervals (1 to 300):

Time Interval Distance	0.3s	0.5s	1s	2s
0.1 m	✓	✓	✓	✓
0.5 m	✓	✓	✓	✓
1 m	✓	✓	✓	✓
5 m	✓	✓	✓	✓
10 m	✓	✓	✓	✓
20 m	✓	✓	✓	✓

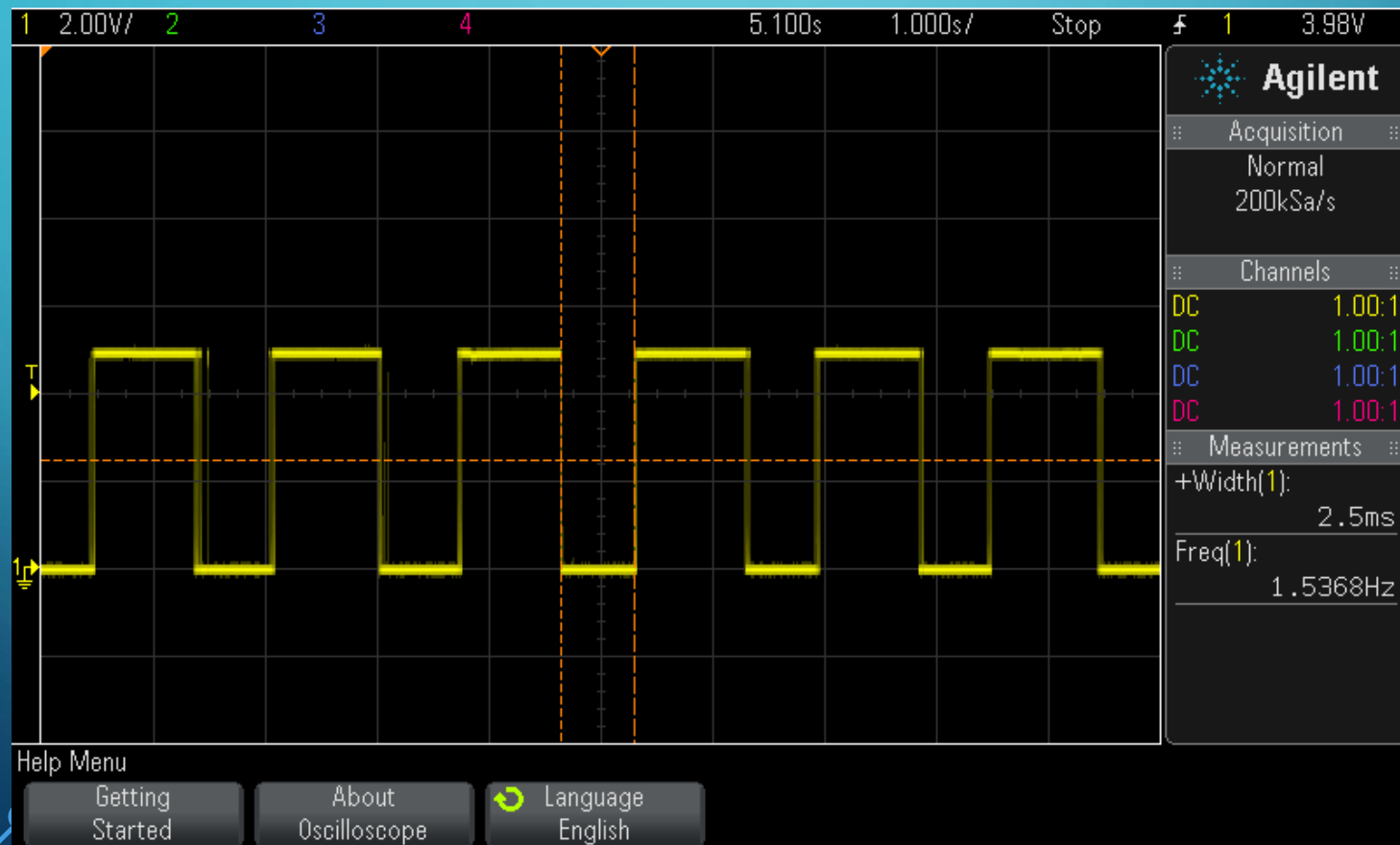
```
COM8 - PUTTY
Counter:1
Counter:2
Counter:3
Counter:4
Counter:5
Counter:6
Counter:7
Counter:8
Counter:9
Counter:10
Counter:11
Counter:12
Counter:13
Counter:14
Counter:15
Counter:16
Counter:17
Counter:18
Counter:19
Counter:20
Counter:21
Counter:22
Counter:23
Counter:24
Counter:25
Counter:26
Counter:27
Counter:28
Counter:29
Counter:30
Counter:31
Counter:32
Counter:33
Counter:34
Counter:35
Counter:36
Counter:37
Counter:38
Counter:39
Counter:40
Counter:41
Counter:42
```

SENSOR (REQUIREMENTS)

- Sensor is able to produce correct output based on the action of locking and unlocking
- Sensor output is consistent when locking and unlocking very fast (once/s)

SENSOR (VERIFICATIONS)

- Oscilloscope output:



MOTOR (REQUIREMENTS)

- Before attaching: rotate correct angle consistently (20 trials)
- After attaching: provide enough torque to lock and unlock correctly (20 trials)

MOTOR (VERIFICATIONS)

- Before attaching:
 - Measure required angle
 - Rotating required angle correctly 20 times
- After attaching:
 - Enough torque to lock and unlock
 - Precise rotations for 20 trials



BUZZER

- Requirements: Able to hear the buzzer at various distance (<20m/ within boxes/ in separate rooms)

Conditions Distance	Open Space	Inside Locker	Adjacent Room
1 m	✓	✓	✓
5 m	✓	✓	✓
10 m	✓	✓	✓
15 m	✓	✓	✓
20 m	✓	✓	✓

MODIFICATIONS

- Ethernet component removed from original design
 - Added remote control via Bluetooth
- Servo rotation based on speed and time instead of angle
 - The servo motor does not support direct input of angle
 - Calculated speed and time for correct operation

FAILED REQUIREMENTS

- Battery Lifetime (>45 days)
 - Based on calculations, 45 days cannot be achieved
 - Best lifetime based on existing components is around 20 days with reasonable assumptions
 - Modification from current design could introduce future solutions

FUTURE WORK

- Use broadcast protocols instead of Bluetooth
- Add an SD card as a storage unit
- Use wall power for lock device
- More efficient PCB design

THANK YOU

