Mirror with Smart-Touch Display Assembly Transcript

ECE 4011 Senior Design Project

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Submitted

November 19, 2020

Table of Contents

Ι.	Hardware Testing	3
	A. Display unit	
	B. IR Frame	
П.	Raspberry Pi 4	5
	A. Assembling the Raspberry Pi	5
	B. Windows IoT OS – Obstacles	6
	C. Windows IoT OS – Installation	7
	 i. STEP 1: Get the Windows OS image file downloaded ii. STEP 2: Get the WoR Imager iii. STEP 3: Booting up the Raspberry Pi iv. STEP 4 (Optional): Increasing Performance Options D. Rainmeter 	7 12 17 20 22
	i. Installation ii. Managing Skins	22 23
.	Mirror Film Installation	23

I. Hardware Testing

A. Display unit (TV)

It is noteworthy mention that two TVs during the entire prototype process. The first TV had a hardware malfunction where it would not even turn on. Troubleshooting procedures were done to determine TV itself was at fault.

- Methods included:
 - Testing port with different devices All devices success
 - Testing TV on multiple ports TV failed all tested ports

The second monitor turned on successfully. Once turned on, the TV was set up as instructed on the First-Time boot settings. Next, all the I/O ports on the TV's onboard peripherals, i.e. HDMI, AUX, USB, were tested. All peripherals worked successfully.

Once the IR frame was assembled, assembly steps on next section, the IR frame USB connector was connected onto a USB 2.0 port on the personal Windows PC system, and the PC system was display output was connected to the TV HDMI 1 port via a HDMI connector. Testing procedures are discussed in a later section.

B. IR Frame

The IR Frame came as 4 separate parts.



Assembly was very easy. Each part are labeled and you are instructed to attach sides with correct labels (A-A, B-B, C-C, and D-D) and secure it with 2 screws for each attached side, as shown below.



Figure 1. IR Frame Assembly. For more information, click <u>here</u> to be directed to Green Touch's 32" IR frame info site

The IR frame came with a pre-installed driver compatible for various operating systems, such as Linux, Mac OS, and even Windows. Prior to testing the functionality of the touch capabilities on the raspberry pi, the hardware lead connected the USB connection onto a personal windows PC system that was connected to a 32" TV. The 10-point touch functionality. Figure 1 and 2 shows the pre- and post- connection of the system configuration page of the personal Windows system.



Figure 2. Screenshot of personal Windows System configuration showing no touch support

	System			- 🗆 X
	→ × 🕈 🔜 > Control Pane	I → System and Security → Sys	len	
File	Edit View Tools Control Panel Home	View basic information	about your computer	0
* * *	Device Menager Remote settings System protection Advanced system settings	Windows edition Windows 10 Home © 2020 Microsoft Corporat	ion. All rights reserved.	Windows 10
		Processor Installed memory (RAM): System type: Pen and Touch:	Intel® Cone(TM) 27-1730H CPU @ 2,000Hz 2,59 GHz 16.0 GB 54-bit Operating System, v34-based processor Tewch Support with 10 Touch Points	Lenovo.
		Computer name, domain, and Computer name. Full computer name: Computer description: Workgroup:	vorkgroup settings LAPTOP-CIERSOCR LAPTOP-CIERSOCR WORKSROUP	Support Information
	See also Security and Maintenance	Windows activation Windows is activated Rea ProductID: 00325-01009-9	d the Microsoft Software License Terms 1999-AAOEM	Change product key

Figure 3. Screenshot of personal Windows system configuration showing 10-point touch capabilities after IR Frame connected

II. Raspberry Pi 4

Model used: CanaKit Raspberry Pi 4 8GB



Figure 4. Components of CanaKit RP4 model used. Click here to be direct to the Canakit Raspberry Pi 4 user manual

The starter kit included:

- Heatsinks modules x3
- Low-noise bearing system fan x1
- High-gloss case with integrated fan mount
- MicroHDMI-to-HDMI
- microSD card USB adapter w/ 32GB Samsung microSD card preloaded with noobs
 provided microSD card was not used
- Raspberry Pi 4 Model B: 8GB RAM | Quad-core 64-bit ARM v8 at 1.5Hz
 - Includes WiFi/Bluetooth 4.0 module
 - 8GB SDRAM with a two-lane LPDDR4 system
 - GPIO Header (used for fan)

All ports and modules are completely functional

A. Assembling the Raspberry Pi

First, we needed to determine which onboard modules to place the heatsinks on. After research, the three modules that were determined to produce the highest heat runoff were the Broadcom CPU, the memory module, and the USB controller module, which controls all the I/O peripherals including USB ports, HDMI ports, Ethernet port, AUX w/ACV port.

Next, the bearing system fan will need to be integrated to the raspberry pi unit. To do so, we connect the two fan wires and connect the red wire to GPIO Header Pin 4 and the black wire on Pin 6, as shown in Figure 5 below. Pin 4 is the 5V power pin which powers the fan during use while Pin 6 is ground. A completed raspberry pi assembly with heatsinks and fan are shown in Figure 6.



Figure 5. Onboard GPIO configuration for fan



Figure 6. Assembled Raspberry Pi, showing fan installed on case's fan mount connected to GPIO pins 4 (red wire) and pins 6 (black wire) and the three heat sinks

One option for lower fan speed and noise is to connect the fan red power wire to Pin 1, rather than Pin 4. Pin 1 is also a power pin but a 3.3V header pin. Then attach the fan onto the case's fan mount then close the case. Figure 4 above shows the completed assembled image with heatsinks and fans integrated.

B. Windows IoT Arm OS – Obstacles

Installing Windows OS is problematic since there really is no official and mainstream windows OS with compatibility for any raspberry pi models, including current generation. Currently the only method is to install windows via an unofficial format of WoR, Windows on Raspberry Pi. Since it is an operating system that is not supported by current raspberry pi, there are faulty and non-functional aspects. Windows installation through WoR limits the onboard RAM to a usable 3GB regardless of

whether it is the 4GB or 8GB model specification but limits it to 1GB for 2GB RAM models. It also disables all onboard I/O ports and drivers, including audio, Wi-Fi, and Bluetooth drivers, while making the end configuration noticeably slow compared to a raspberry pi with a Linux or Mac OS based operation.

Now the WoR developers have patched all their Windows OS with a fix enabling functional onboard I/O ports, which does allow for a functional onboard ethernet. However, all the drivers are still disabled. A noteworthy reminder is that because the USB ports are functional, audio, Wi-Fi, and Bluetooth functionalities can be accommodated through a respective USB adapter. There are limited USB ports on the raspberry pi, however a simple fix is using a dedicated USB port for a USB hub for all adapters.

As for the memory limitation, there is a way to allow the device to have full usable RAM capacity. It can be done by disabled the system memory limiter manually on the device boot manager itself. This will fix the ram limitation to where it functions on all the system memory configuration, in our case is 8GB. An updated version of the WoR Windows10 Core was installed that patched the port issues on boot-up. The drivers are all still disabled. However, since the ports are all working a work-around solution can be to use USB adapters for each driver. The ethernet port is functional so we have access to the internet via ethernet. With audio issues, the driver basically doesn't exist. So other than getting an audio adapter, another method could be to manually reroute all audio directly to the TV system with the HDMI output controls. Essentially, it will be like manually registering the TV audio driver as the raspberry pi's audio driver. Coincidentally, the mic that was ordered though Amazon was an USB audio driver with an integrated mic extension.

C. Windows IoT Arm OS - Installation

* Before Proceeding with installation steps below, create a folder somewhere on your system. This folder will be temporary and can be deleted post-installation; create the folder on your <u>desktop</u> for convenient access. Throughout this section this folder will be referred to as "**primary directory**" *

i. STEP 1: Get the Windows OS image file downloaded

There are two methods of obtaining an Windows OS .iso file, both of which are noteworthy to remember. One is through the WoR discord server and the other is through UUP. Both are very important resources to refer to or take advantage of. Windows on Raspberry Pi is still in beta constantly undergoing updates and patches. The discord server includes developer users developing and updated patched files in the channel. It's also a great resource to ask questions relating to Windows on Raspberry Pi or Raspberry Pi in general where the developer users and other participants in channels will be able to help solve or share relevant solutions. The other method, via UUP, is a repository of every windows version.

Method 1: Windows on Raspberry Pi Discord server

If you already have the Discord Desktop App, open it now. If not, you can click here to download it and run through the installation process then open it. Or you can use the

Discord Web App and the corresponding images below should be identical whether you are using the desktop app or the web app.

1. Once you open discord, on the left-hand side, click on the "explore servers" options under the list of servers as shown below.

SISCORD											
			🗠 Friends	Online	Pending 🔕	Blocked	Add Friend				
	💁 Friends		ONLINE-6								
	1 Nitro									•	
	DIRECT MESSAGES	•								•	
										•	
										•	
										•	
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0											(
4											

2. Search "Windows on Raspberry Pi" on the search box and you should get one server result as shown below



3. Open the server and it should take you to the server home as shown below. You need to activate access yourself by selecting any one of the emojis in the message box telling you to react to the message with an emoji; emojis are marked in red box in picture below



4. Once you gain access, you should have be able to see all the channels in left-hand side of the discord server, you need to look for and click on the channel labeled "# -wor-tool-images" shown below



5. Opening the "# -wor-tool-images" channel will take you a repository of two different WoR .iso file build versions. You can choose either the build version 0.2.5 Codename Midnight Falcon or version 0.2.7 Project Neon. You download either version via a torrent file or using mega.nz but make sure you save it in the **Primary Directory**. It works best if downloaded via the torrent file, in which case you need a torrent software such as uTorrent (install with default steps shown in setup and add the torrent and set the unpack directory to the **Primary Directory**). The iso file from the torrent or the mega.nz will in a *.wim* format. You will be using this *.wim* file for the WoR image in the **Step 2: Get the WoR imager**.



Method 2: Windows through Unified Update Platform (UUP).

1. Click <u>here</u> to be directed to UUP. Should direct you to the page below. For category "Select Type" click on the drop-down box and select "*Windows (Final Version)*"

Apps Entertainment Georgia	Tech 🧲 internet speed test 📕 Shanning 👼 Chrome Remote De			x 🖬 🖩
···· · · · · · · · · · · · · · · · · ·				
	Select type:			
	- Select type -	~		
	Select version:			
	- Select version -	~		
	Select language:			
	- Select language -	¥		
	Select edition:			
	- Select edition -	~		
	Select type download:		•••	inde Bright
	- Select type download -	~		

2. For the Select version category, ONLY select any version with the [arm64] type. Noteworthy mention is version 1909 [arm64] is a version with an unpatched firmware so you will not have any function onboard I/O. All other versions should work with functional I/O.

- Select version -	`
- Select version -	
Feature update to Windows 10 Team [x64]	
Feature update to Windows 10, version 20H2 [x64]	
Feature update to Windows 10, version 20H2 [x86]	
Feature update to Windows 10, version 20H2 [arm64]	
Feature update to Windows 10, version 2004 [x86]	
Feature update to Windows 10, version 2004 [arm64]	2
Feature update to Windows 10, version 2004 [x64]	
Feature update to Windows 10, version 1909 [arm64]	
Feature update to Windows 10, version 1909 [x86]	
Feature update to Windows 10, version 1909 [x64]	
Feature update to Windows 10, version 1903 [x64]	
Feature update to Windows 10, version 1903 [arm64]	
Feature update to Windows 10, version 1903 [x86]	
Feature update to Windows 10, version 1903 x86 2019-04 [x86]	
Feature update to Windows 10, version 1903 arm64 2019-04 [arm64]	
Feature update to Windows 10, version 1903 x64 2019-04 [x64]	
Feature update to Windows 10, version 1903 amd64 2019-04 [x64]	
Feature update to Windows 10, version 1809 x86 2020-11B [x86]	
Feature update to Windows 10, version 1809 x64 2020-11B [x64]	-

3. For the remaining categories, select the options as shown on the image below.



4. Once the categories are filled you there should be two .cmd shown to the right, as shown below. Download both .cmd scripts to the **Primary Directory**.

Select type:	
Windows (Final version)	v
Select version: Feature update to Windows 10, version 2004 [arm64]	File creatingISO.cmd according to the link was generated: creatingISO_19041.610_en-us_arm64_professional.cmd
Select language:	<pre>multi_creatingTS0_19041.630_en-us_arm64_professional.cmd</pre>
en-us. English (United States)	This script will help you to create on the fly directly the ISO file with
Select edition:	those edition which you specified in case of a choice.
Windows 10 Professional	Full number build: vb_release_svc_prod1.19041.630.201103-1642
Select type download:	Details about the Build: MSBuild's Blogs WIP
Download ISO compiler in OneClickI (run downloaded CMD-file)	J
	Total available files: 5576782 Total volume of files: 49.03 TB (5480507166931 bytes)

5. Open the folder you saved the two .cmd script files. Open the .cmd scrip file labeled *creatingISO_19041.630_en-us_arm64_professiona.cmd* (if the name varies, it will be the one that doesn't have *multi_* in the name). A similar popup as below should appear on your window, click *More info* then click *Run Anyway*

Windows protected your PC	Windows protected your PC
Microsoft Defender SmartScreen prevented an unrecognized app from starting. Running this app might put your PC at risk. <u>More info</u>	Microsoft Defender SmartScreen prevented an unrecognized app from starting. Running this app might put your PC at risk. App: creating SO_19041.630_en-us_arm64_professio nat.cmd Publisher: Unknown publisher
Don't run	Run anyway Don't run

6. Once you click *Run Anyway*, a command terminal should appear with the script automatically running. DO NOT DO ANYTHING. The script, depending on your internet speed, takes anywhere from 1 to 4 hours to complete. Once completed, close the command terminal, and go to the **Primary Directory**. You will see a *.ISO* file that the command script generated. You will be using this *.ISO* file for the WoR image in **Step 2: Get the WoR Imager**.

Name	Date modified	Туре	Size	
🦲 bin	17/07/2020 12:15	File folder		
uup	17/07/2020 11:24	File folder		
19041.388.200707-0737.VB_RELEASE_SVC_PROD1_CLIENTPRO_OEMRET_A64FRE_EN-US.ISO	17/07/2020 13:02	iso Archive	4,986,682 KB	
creatingISO_19041.388_en-us_arm64_professional.cmd	17/07/2020 11:21	Windows Comma	3 KB	
multi_creatingISO_19041.388_en-us_arm64_professional.cmd	17/07/2020 11:21	Windows Comma	7 KB	10

ii. **STEP 2.** Get the WoR imager

1. Click <u>here</u> to be directed to the WoR imager site and download the latest version of imager setup application



2. Go to the location the imager .zip file was downloaded and click on the *Extract all* option as shown below and make sure to unzip to a Folder labeled "WoR" in the **Primary Directory**

The Home Share	View Compressed Folder Tools winklast Lah 15_metuger2 - darght Falcan Lah 25_metuger2 - b 0_MCL Lah 4 -	utad ←					
	Extract To						
+ → + ↑ 📑 👘							
	Name	Type	Compressed size	Password Size		Ratio	Date modified
Quick access Downloads Pictures Oesktop	ssets Ling Ling Lib	File folder File folder File folder File folder					10/13/2020 9:26 PM 10/13/2020 9:26 PM 10/13/2020 9:26 PM 10/13/2020 9:27 PM 10/13/2020 9:28 PM
	 INIFieParser.dll Joveler.Dynl.oader.dli ManagedWimi.ih.dll 	Application extension Application extension Application extension	13 KB 6 KB 27 KB	No No No	28 KB 12 KB 71 KB	57% 57% 63%	7/23/2017 1-17 PM 4/22/2020 4-24 PM 10/31/2019 6:21 PM
This PC	Microsoft,Dism.dll Microsoft,Wim.dll Microsoft,Wimdows,APICodePack.dll	Application extension Application extension	23 KB 18 KB 41 KB	No No	57 KB 50 KB	60% 66%	6/16/2020 10:41 PM 7/30/2018 6:30 PM 3/4/2020 6:25 PM
Desktop	Microsoft.WindowsAPICadePack.S., Newtonsoft.Json.dll	Application extension Application extension	169 KB 248 KB	No No	501 KB 684 KB	67% 64%	3/4/2020 6-25 PM 11/9/2019 1-56 AM
Downloads	 MLog.dll MLog.Windows.Forms.dll System Management Automation 	Application extension Application extension Application extension	301 KB 22 KB 2,156 KB	No No No	851 KB 97 KB 6,987 KB	60% 78% 70%	7/31/2020 11:03 PM 6/17/2019 11:25 PM 11/25/2015 11:03 PM
Videos	WoR WoR.ese.config	Application CONFIG File	203 KB 1 KB 57 KB	No No	586 KB 1 KB	66% 44% 50%	10/13/2020 9:26 PM 7/3/2020 9:13 PM 10/13/2020 9:26 PM
👝 Data (Dt)			or Ha		Contract of		

3. Open the folder you just extracted the imager .zip file to. Open WoR.exe (the file type would be listed as Application) as shown in the image below. Click *Allow* if a permissions popup appears.

~P r	jours.				
Na	me	Date modified	Туре	Size	
	assets	11/14/2020 1:32 AM	File folder		
	lang	11/14/2020 1:32 AM	File folder		
	lib	11/14/2020 1:32 AM	File folder		
	res	11/14/2020 1:32 AM	File folder		
\$	INIFileParser.dll	11/14/2020 1:32 AM	Application exten	28 KB	
\$	Joveler.DynLoader.dll	11/14/2020 1:32 AM	Application exten	12 KB	
6	ManagedWimLib.dll	11/14/2020 1:32 AM	Application exten	71 KB	
4	Microsoft.Dism.dll	11/14/2020 1:32 AM	Application exten	57 KB	
\$	Microsoft.Wim.dll	11/14/2020 1:32 AM	Application exten	50 KB	
4	Microsoft.WindowsAPICodePack.dll	11/14/2020 1:32 AM	Application exten	101 KB	
4	Microsoft.WindowsAPICodePack.Shell.dll	11/14/2020 1:32 AM	Application exten	501 KB	
4	Newtonsoft.Json.dll	11/14/2020 1:32 AM	Application exten	684 KB	
4	NLog.dll	11/14/2020 1:32 AM	Application exten	851 KB	
\$	NLog.Windows.Forms.dll	11/14/2020 1:32 AM	Application exten	97 KB	
4	System.Management.Automation.dll	11/14/2020 1:32 AM	Application exten	6,987 KB	
-	WoR	11/14/2020 1:32 AM	Application	586 KB 🥠	
	WoR.exe.config	11/14/2020 1:32 AM	CONFIG File	1 KB	
4	WoR.FlatUI.dll	11/14/2020 1:32 AM	Application exten	159 KB	

4. This software window should appear as shown below and click Next

a 19	Windows on Ra	aspberry				About	Logs _	×
	Welcome	Select device	Select image	Select drivers	UEFI firmware	Configuration	Install	
		Welc This wiz on you Click or	ome to Wi zard will help yo r Raspberry Pio n the Next butt	ndows on ou easily install computer. on to continue.	Raspberry the full deskto	/! op version of W	indows 10	
		Select y	our language:	English		=		
							Next →	

5. Make sure you have an SD card adapter with a microSD card plugged into a USB port on your system. Click the dropdown menu, as shown below and select the SD device as your storage drive. If you don't see your SD device, make sure its plugged in correctly and click the refresh icon. MAKE SURE YOU SELECT THE SD DEVICE ONLY, otherwise it will reformat your system. Select *Raspberry Pi 4 [ARM64][Experimental]* as the device type and click *Next*

Ш.	Windows on	Raspberry				About	Logs 🗕 🗙
	Welcome	Select device	Select image	Select drivers	UEFI firmware	Configuration	Install
			Sele	ct the de	vice		
		Storage drive					
		Disk 2 - SanDisk (Cruzer Dial USB Devi	ce - Removable Med	ia - 29 GB		
		Warning! Selecting	g the wrong drive m	nay lead to unwanted	l data loss.		
		Device type					
		Barm64 Supported	ry Pi 2/3 [ARM64 1 models: Pi 2: [rev] 1.2], Pi 3: [B, B+]			
		₩4 Raspberr ARM64 Supported	ry Pi 4 [ARM64] [i I models: B	Experimental]			
		Raspberr	ry Pi 2/3 [ARM32 I models: Pi 2: [rev] [Experimental] 1.1, rev 1.2], Pi 3: [B,	B+]		
						← Back	Next \rightarrow

 If you used Method 1 in the previous step where you got your Windows OS image, select the .wim file you unpacked and downloaded from the discord server then click *Next*. If you used Method 2, then select the .iso file that the .cmd command script generated then click *Next*



7. Select the option Use the latest package available on the server and then click Next



8. Select the option Use the latest firmware available on the server and then click next



9. Click Advanced and a Warning! popup should appear. When it asks to continue, click Yes

🧱 Windows on F	Raspberry				About	Logs 🔔 🔀				
Welcome	Select device	e Select image	Select drive	rs UEFI firmware	Configuration	Install				
General	Adva	Cor	nfigura	ation		Ö				
										×
Partition schem	e:	Master Boot Record (MBF	v 🔳	arm_64bit=1		^				
Install image wi	ith:	Windows Imaging	=	uart_2ndstage=1				Warning!		
				enable_gJC=1 armstub=RPI_EFI.fd disable_commandline_tags=1 disable overscan=1		~		Changing the default settings i specific device features or preve	n the advanced me ent the system fro	enu may disable n booting.
Save this of Note: options	onfiguration that are disable	on exit d (and those in the Advance	ed menu) will r	not be saved.				Are you sure you want to conti	nue?	
					← Back	Next \rightarrow	Don't	show this again	Yes	No

10. Type in *8192* for the memory limit. This will allow the raspberry pi to recognize the maximum capacity of the onboard memory on boot.

if your raspberry pi is a 4GB ram model, type 4096 instead of 8192 since the maximum ram of 4GB model is 4096MB

Click Next

1	Windows on R	aspberry				About	Logs _ 🗙
	Welcome	Select device	Select image	Select drivers	UEFI firmware	Configuration	Install
			Co	nfigurati	on		
	General	Advanced					O
		options					
1	Memory limit:	8192	t MB				
63	Enable the Wir	ndows Recovery Env	ironment				
	Save this co Note: options	onfiguration on e that are disabled (an	xit d those in the Advan	iced menu) will not be	saved.		
						← Back	Next \rightarrow

11. Make sure all information is accurate and double check the storage device and device type to make sure you selected the correct storage drive to stall the imaging process. Click *Install*. Installation will take a few hours to complete. Once finished, move on to the next steps (optional) if you want to over clock your raspberry pi unit. Otherwise, move on to Step 3: Booting up the Raspberry Pi

1	Windows on Ra	spberry						About	Logs _	×
	Welcome	Select device	Select image	Select	drivers	UEFI firmwa	re Co	nfiguration	Install	
			Installa	tio	n ove	rview				
	Disk 2 - SanDisk	k Cruzer Dial USB	Device - 29 GB		worproject/RPi-Windows-Drivers					
	Raspberry Pi 4 [ARM64]								
					pftf/RPi4					
	Windows 10 Pro	o build 19041.388								
	Windows Imagi	ing	MBR			N	10			
								← Back	→ Insta	all

12. Once the installation on your boot storage device is completed, go into File Explorer, and open the boot drive of the installed storage device as shown below. Then open the *config.txt* file

		-		· · · ·		
← → • ↑	This PC	BOOT (K:)				
		Name ^	Date modified	Туре	Size	
🗸 📌 Quick access		_ m	11/0/2020 12:02 414	The fielder		
🕹 Downloads	*	EFI	11/9/2020 12:03 AIVI	File Tolder	47.1/0	
Pictures	*	Bernz / II-Ipi-4-b.dtb	11/0/2020 10:07 PW	Trut Document	47 NB	
Desktop		Coning	11/0/2020 10:34 PIM	DAT File	I ND	
ECE 4011		Peadma.md	11/8/2020 10:07 PM	MD File	0 ND	
Lab 10 bashura2		release	11/0/2020 10:07 PM	File	1 / 2	
			9/1/2020 2:09 DM	ED Eile	1 09/1 1/12	
New folder		ctart4 olf	11/9/2020 10:07 DM	ELE Eilo	2 221 KB	
🗸 💻 This PC		Startesch	170/2020 10:07 PW		2,231 KD	
3D Objects						
> 📃 Desktop						
> 音 Documents						
Downloads						

13. Add the following lines in the *config.txt* as shown and save the file. When done, close out of the *config.txt* file and eject the SD adapter and remove the SD drive from the adapter.

```
File Edit Format View Help
arm_64bit=1
enable_uart=1
uart_2ndstage=1
enable_gic=1
armstub=RPI_EFI.fd
disable_commandline_tags=1
disable_overscan=1
device_tree_address=0x1f0000
device_tree_end=0x200000
dtoverlay=miniuart-bt
over_voltage=6
arm freq=2000
```

*config - Notepad

Note: This additional two lines of code allows the raspberry pi to adjust power consumption for the overclocking (6V) and set the desired overclock rate. The recommended overclock buffer for a raspberry pi is between 2000 to 2500MHz. Our overclock rate was set to 2000.

iii. **STEP 3:** Booting up the Raspberry Pi

Eject the SD adapter from your computer device and take out the SD drive and plug it into the raspberry pi SD slot module. If you have not already assembled the raspberry pi device, follow the **Assembling the Raspberry Pi** section earlier in the document. Connect the raspberry pi to the TV via the MicroHDMI-to-HDMI cable and plug in the power supply via the USB-C power port. On

startup press FI on your keyboard when you see the raspberry pi logo on the screen. You should see the below screen.

Raspberry Pi 4 Model B BCM2711 (ARM Cortex-A72) UEFI Firmware v1.20		1.50 GHz 3072 MB RAM
Select Language • <u>Device Manager</u> • Boot Manager • Boot Maintenance Manager Continue Reset	<english></english>	This selection will take you to the Device Manager
†↓=Move Hiahliaht <e< td=""><td>nter>=Select Entru</td><td></td></e<>	nter>=Select Entru	

Go into Device Manager and move the scroll to Raspberry Pi Configuration and press Enter

	Device Manager	
Devices List Secure Boot Configuration Console Preference Select RAM Disk Configuration Driver Health Manager Tls Auth Configuration Raspberry Pi Configurat iSCSI Configuration Network Device List	on ction ion	Press <enter> to configure system settings.</enter>
Press ESC to exit.		
		P P
†↓=Move Highlight	<enter>=Select Entry</enter>	Esc=Exit

Select *Advanced Configuration*. A noteworthy mention is if you are looking to overclock you raspberry pi device, go into *CPU Configuration* and select *Custom* and then type the overclock rate you saved on the *config.txt* earlier. This will not overclock you raspberry pi but it is just setting the maximum allowed overclockable threshold for you device. The additional code to the *config.txt* shown at the end of **Step 2: Getting WoR imager**

	Raspberry Pi Configurat	ion	
 CPU Configuration Display Configuration idvanced Configuration SD/MMC Configuration Debugging Configuration) on		
†↓=Move Highlight	<enter>=Select Entry</enter>	Esc=Exit	

Change the *Limit RAM to 3GB* setting to *Disabled*. This will allow the raspberry pi to use all the full onboard RAM capacity whether you are using a 4GB or 8GB model. For 2GB model, it will say *Limit RAM to 1GB*.

	Advanced Configuration	
Limit RAM to 3 GB	(Disabled)	OSes not supporting
System Table Selection	(ACPI)	ACPI DMA constraints
ACPI fan control	(Disabled)	require a 3 GB limit
ACPI fan temperature	[60]	or face broken xHCI
Asset Tag	-	USB
]	F9=Reset to Defaults	F10=Save
†↓=Move Highlight ↔	(Enter>=Select Entry	Esc=Exit

Press *ESC* key on the keyboard and a save changes popup will appear then press the *Y* key on the keyboard to save and exit the *Raspberry Pi Configuration* menu.

	Raspberry Pi Configurat	ion	
 CPU Configuration Display Configuratio Advanced Configurati SD De Change Press 'Y' to save 	n om s have not saved. Save Cha and exit, 'N' to discard	nges and exit? and exit, 'ESC' to can	cel.
†∔=Move Highlight	<enter>=Select Entry</enter>	Esc=Exit	

Scroll to and select *Continue* and a configuration change popup will appear and then press *Enter* on your keyboard.

Raspberry Pi 4 Model B BCM2711 (ARM Cortex-A72) UEFI Firmware v1.20	1.50 GHz 3072 MB RAM	
Select Language <eng Device Manager Boot Manager Boot Maintenance Manager Continue Reset</eng 	;lish> Continue	Configuration changed. Reset to apply it Now. Press ENTER to reset
†↓=Move Highlight <enter>=</enter>	-Select Entry	

Your raspberry pi unit will restart and boot up with the Windows OS. Follow the Windows startup settings as directed. Make sure your raspberry pi is connected to ethernet. To check if your raspberry pi's RAM is running on its full capacity, you can check using one of the following ways.

- Open task manager (right-click on your task bar and click *task manager* or click on the windows icon and search *task manager*) then go to the performance tab and check the memory usage. It will be a few 100MB less than what your full onboard memory capacity is. This is because task

manager takes displays only the usable memory space and the 100MB or so is the header buffer memory used by the Windows OS.

- The other way to check is to open *Control Panel* (click the windows icon and search *control panel*) navigate to *System and Security* and then *System*. Next to the *install ram* under the under the *system* section under the *System* settings.

iv. Step 4 (Optional): Increasing performance options

- 1. Open *Task Manager* and select the *Startup* tab and disable all programs except Rainmeter
- 2. On your keyboard press, the Windows key + R then type sysdm.cpl and press OK.

💷 Run	×
٨	Type the name of a program, folder, document, or Internet resource, and Windows will open it for you.
Open:	sysdm.cpl 🗸
	OK Cancel <u>B</u> rowse

Select the Advanced tab and click on Settings under Performance section.

System Propertie	25			-	\times
Computer Name	Hardware	Advanced	System Protection	Remote	
You must be lo Performance Visual effects	gged on as a	an Administral	tor to make most of ti emory usage, and vir	hese change tual memory Settings	es.
User Profiles Desktop settir	ngs related to	o your sign-in		Settings	
Startup and R System startu	lecovery p, system fai	lure, and deb	ugging information	Settings	
		ОК	Environme	ent Variables. App	

Select the option *Adjust for best performance*, which should disable (uncheck) all options under the custom section. Click *Apply* then *OK*. Reboot your raspberry pi.



D. Rainmeter

Rainmeter is an open-source desktop customization tool and is the software that was used for the touch-interactive smart mirror. This section discusses installation of Rainmeter and user experience for getting started.

i. Installation

To install Rainmeter, click <u>here</u> to be directed to website for downloading Rainmeter. Download the latest version of Rainmeter, it can be the latest Beta or Final release version.



Install Rainmeter using the default settings. Select Standard installation and click Next.

📸 Rainmeter Setup	- 🗆 X
6	Welcome to Rainmeter Setup
	Select the type of install:
	Standard installation (recommended) Installs Rainmeter and downloads required libraries.
	Portable installation Do not select this unless you know what you're doing. Shortcuts will not be created and the .rmskin extension will not be registered. The Visual C++ and .NET 2.0 libraries may need to be manually installed.
	<u>N</u> ext > Cancel

Select an installation directory of your choosing or leave the default destination address. Make sure to enable *Launch Rainmeter on Startup* option and then click *Install*. When the installation is complete, restart your device.

ii. Managing Skins

Rainmeter offers the flexibility for users to create their own desktop layout profile or pick and choose from thousands of different layouts and templates through skins packages. There are several sources where you can find pre-made skins made from other users, found <u>here</u>. Or click on each source to be redirected directly:

Deviant Art_Rainmeter [need to create an account to be able to download skins] <u>r/Rainmeter</u> – Reddit <u>Rainmeter Forums</u> <u>Rainmeter Discord Server</u> <u>Flickr_Rainmeter</u>

Browse through the different skins and select skin(s) that you like and download them. The downloaded file(s) should show up as a *.rmskin* as shown in the example below.



Double-click the downloaded *.rmskin* file and a Rainmeter Skin Installer for that skin package should appear as below. Click *Install*

💽 Rainmete	r Skin Installer	-		×
Name: Author: Version: Included co	Mangotsfield Spike=hubert=spike 1.0 omponents:	:0887		
Name Skins — Mange	otsfield	Action Backup and replace	2	_
Advanced	1 -	Install	Cano	:el

Once you download all the skin packages that seem appealing to you and you have installed them as directed above, you can open *Skin Manager* where all the skin packages are consolidated

The Manage window in Rainmeter is the primary means of controlling the application and skins. Manage is accessed in several ways:

- Left-Click the Rainmeter icon in the Windows Notification Area on the taskbar.
- Right-Click the Rainmeter icon in the Windows Notification Area on the taskbar and

select "Manage".

	Rainmete	r	
ø	۵		
84%	^ ⊡ �))	12:31 PM 11/19/2020	22

• Right-Click any running skin on the desktop and select "Manage skin".

You can expand each parent skin package folder as shown below. List of currently installed skins. This contains all Skins found when Rainmeter is started or refreshed.

Skins Layouts	Settings		
Active skins 👻	40 ···	Load Refresh Edit	:
> Atome	Author		
illustro	Version:		
Mangotsfield	License:		
Skins	Information:		
	Coordinates:	Display monitor	
	Coordinates:	Display monitor	
	Coordinates:	Display monitor	
	Coordinates:	Display monitor Draggable Click through Keep on screen	,
	Coordinates:	Display monitor Display monitor Display monitor Click through Keep on screen Save position	7
Create , rmskin package	Coordinates:	Display monitor Display monitor Draggable Click through Keep on screen Save position Save to edges	

The list consists of the config folder for each skin, and the skin .ini files for each config.

- Clicking on a skin .ini file will make that skin active in the Manage tab.
- Double-clicking a skin .ini file will unload the skin if it is running, or load it if not.
- Right clicking on a config folder will allow opening the folder in Windows Explorer.
- Right clicking on a skin .ini file will allow loading, unloading or editing the skin.

The list is updated when Rainmeter is refreshed. You will see all loaded skins on your desktop

Skins Layouts Se	ttings	
Active skins Active skins Acti	Player.ini Atome\Player Author: Version: License: Information:	Load Refresh Edit DD.921 1.1 Creative Commons: Attribution-Noncommercial-ShareAlike 4.0
Velcome.ini V- Time - Date Lag Time - Date.ini Cold Littor		
✓ Velcome.ini ✓ - Time - Date ✓ - Time - Date ✓ - Ilustro ✓ - Ilustro ✓ - Mangotsfield ✓ - SideBAR	Coordinates:	Display monitor
 ✓ - Time - Date ✓ - Time - Date. ✓ - Cold > - Hustro ✓ SideBAR ✓ SideBAR 	Coordinates: Position:	Display monitor
 ✓ - Skins ✓ Skins ✓ Skins 	Coordinates: Position: Load order:	Display monitor Draggable Click through
 ✓ - Skins ✓ Skins ✓ Skins ✓ Skins 	Coordinates: Position: Load order:	Display monitor Display monitor Draggable Click through Keep on screen Save position
 ↓ Welcome.ini ↓ Time - Date ↓ Time - Date.ini ↓ Cold ↓ illustro ↓ Mangotsfield ↓ SideBAR ↓ Skins 	Coordinates: Position: Load order: Transparency:	Display monitor Display monitor Draggable Click through Keep on screen Save position Save position Snap to edges

Each parent folder (i.e. Atome, Cold, etc.) are examples of installed Skin packages If you have any further questions regarding Rainmeter or managing desktop and skins, click <u>here</u> to be directed to Rainmeter manuals. There are manuals for every version of Rainmeter, including the beta and final versions. Make sure you click on the manual of the Rainmeter version you downloaded.

III. Mirror Film Installation

A one-way mirror, also called two-way mirror, is a reciprocal mirror that appears reflective on one side and transparent at the other. If you are not using an actual mirror, a mirror film can be an acceptable substitution for a mirror. Keep in mind, it will not be nearly as reflective as a normal mirror. However, it will get passable enough to see reflectivity. Mirror films are normally applied to glass to turn it into a one-way mirror, provides both all-day privacy, UV protection, and even help cost reduction through energy savings. For the purposes of this prototype, the following instructions will guide mirror film installation on a monitor or a TV display.