TEAM 3959E

# REVERSE ENGINEERING CHALLENGE

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# WHY WE CHOSE THIS


The item that we reverse engineered was a Huawei Honor 6 Smartphone. It is no longer sold by Huawei. It is about 10 years old. We chose a smartphone because it is a very reliable and integral part of our life, regardless of the kind of user. This one device can also replace a lot of items, such as music players, clocks/alarms, calendars, etc.

It has always been a brewing interest in me to understand how small yet complex devices work, and this was the perfect opportunity to do so. Also, the shear irreplaceable stance the smartphone has in our society today made us choose this device.

# PREREQUISITE REASEARCH

- To help us in dismantling the device, we extensively researched about:

- Essential parts of a smartphone
- Steps to disassemble a phone
- Functions of the motherboard
- Necessary safety precautions

# ANATOMY OF A SMARTPHONE

| Hardware Architecture | Communication Design | User Application Execution | Peripheral Devices | Processors |
|---|---|---|---|---|
| Most Smartphones use Soc Architecture (System on a chip) that combines high level elements of a device into one chip. They include the application processor that runs app data and commands, a modem for radio transmission, and external devices for user inputs/interaction | The Transmission (TX) and Receiver (RX) hardware transmit and receive data. The phone processes incoming/outgoing text, audio, and video. | Apps, like games, audio/video, image processing, are run by the application processor. Apps with lots of graphics are handled by the Graphic Processor Unit (GPU) | Devices used for user interface, like touch screens, buttons, speakers, Bluetooth, etc. | The processor(s) go through several inputs/outputs, programs, data, storage, etc. to help different aspects of the device |

# Important Hardware Components

**CPU** ***(Central Processing Unit)***

The brain of the device, responsible for executing instructions and handling the device's overall performance.

**GPU** ***(Graphics Processing Unit)***

Manages graphical tasks, including rendering images, videos, and games.

**RAM** ***(Random Access Memory)***

Provides temporary storage for running apps and processes,

**DISPLAY**

The screen that shows information, that’s usually an LCD or OLED panel.

**SENSORS**

- Accelerometer: Measures the device's acceleration, enabling features like screen orientation.
- Gyroscope: Measures the device's orientation and rotation.
- Fingerprint/ Face Recognition Sensors: Enhances device security by enabling biometric authentication.

# TECHNICAL SPECIFICATIONS

| Topic | Specification |
|---|---|
| Dimension | 139.6 x 69.7 x 7.5 mm |
| Weight | 130 g (4.59 oz) |
| Chipset | Kirin 920 (28 nm) |
| CPU | Octa Core |
| GPU | Mali-T624MP4 |
| Resolution | 1080 x 1920 pixels, 16:9 ratio |

# SAFETY PROCEDURES

To stay safe while deconstructing the smartphone, we took several precautionary steps, which include:

- Removing all sources of battery/power
- Wearing Safety goggles
- Keeping potential hazards like water away
- Wearing fitting, not baggy clothes
- Dismantling in a quiet, controlled area to prevent mistakes


# DISMANTLING

## HUAWEI HONOR 6

# DISMANTLING PROCESS

### Preparation

- Cleaning the Area
- Gathering tools
- Taking necessary precautions before starting

### Disassembly

- Carefully removing pieces
- Taking pictures
- Taking crucial notes

### Analysis

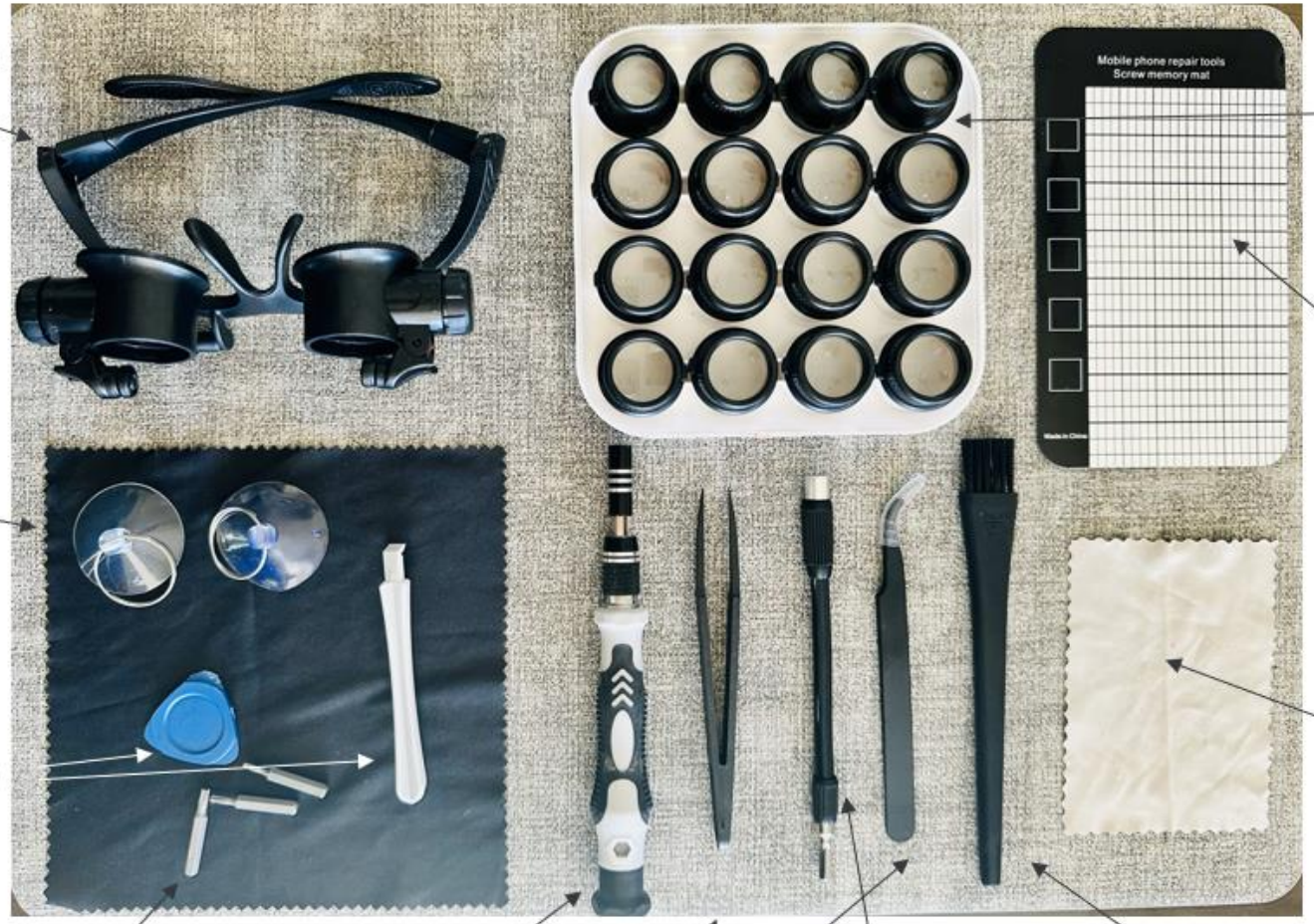
- Analyzing pictures
- Finding minute components (model numbers of parts, etc..)

### Documentation

- Write findings
- Explain results
- Conclude research

# PREPARATION: TOOLS

During the Dismantling, We made sure to wear safety goggles




Magnification Glasses

Magnification Lenses

Phone Screw Memory Mat

Suction Cups

Pry Tools

Cleaning Fabric

Screwdriver Bits

Screwdriver Body

Tweezers

Flexible Screwdriver Bit

Brush

# DISASSEMBLY & ANALYSIS:

## BACK PANEL

- We started by removing the back panel of the phone

- The top left corner was slightly damaged, so we slipped the pry tool into there and started progressing around the phone

- Used a suction cup to pull off the back panel

*The back panel seems to be made of thin but sturdy composite material

- Used a pry tool to remove any remaining adhesive


*Sealent was most probably used to achieve an IP65 rating, a status given to a device stating if it's water & dust resistant or not.*

# DISASSEMBLY & ANALYSIS:

## METAL PROTECTIVE SHIELD

- Next, we began to remove the metal shield


- There were 10 screws on the surface (marked with yellow in the picture) which we first began to unscrew. We used a Phillips 4mm #00 bit to unscrew these. We placed them on the screw memory mat in the correct position.


- We then removed the tape that gives partial stability to the metal shield and took out the screw below it. We also added it to the memory mat. (The 11th screw is shown on the previous figure of the memory mat)


- Used precise metal tweezers to remove the metal shield, revealing the motherboard /PCB

Flash(on the front) and its heat shield

Metal Shield

Speaker

*The metal shield in the Honor 6 serves many purposes, like protecting the motherboard, encasing the back camera, and stopping heat damage*

# DISASSEMBLY & ANALYSIS:

## COMPONENTS

- Next, we began to remove exposed components


Camera (Bottom)

Heat Shield

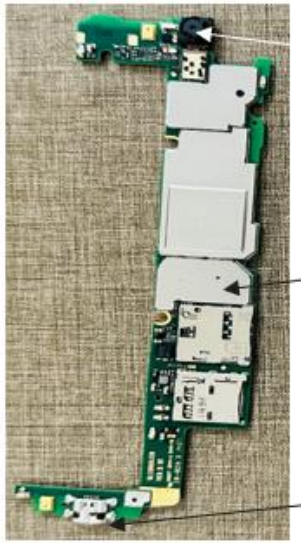
Connector Bed

Connector (Pins)

- We first noticed the back camera. We carefully removed it from its connector bed. We noticed that, like the flash, it had a heat shield

- We then separated the four Board-to-Board connectors (Marked in blue in the picture) to remove the main PCB (Printed Circuit Board)

- We inserted the pry tool into the edges of the phone and carefully pried out the motherboard. We also removed the front camera



Front camera

PCB

USB Charging Port

*The "Connectors mentioned earlier are called "Board-to-Board Connectors. They are used to connect PCB's. These connect to a conductive pattern of indentations on an insulating surface.*

# DISASSEMBLY & ANALYSIS:

## COMPONENTS PT.2

- Next, we continued to remove exposed components


- We first dislodged the now loose headphone jack, to more closely analyze it. After trying to remove it, we noticed it was attached to the vibration motor at the top of the phone

Next, we used the precise metal tweezers to pluck out the vibration motor, along with the headphone jack from its snug position inside phone. This was quite difficult as the placement was very compact

- We completely removed the connector that relays inputs from the external buttons to the phone. We had to slightly bend the plastic strips encasing it to take it out.

Headphone Jack

Vibration Motor

"Buttons Connector"

# DISASSEMBLY & ANALYSIS:

## BATTERY AND LCD SCREEN

- Finally, we began to remove the battery and screen

- The only thing left on the back of the phone was the battery. It was held by a strong adhesive, so it was very difficult to remove. We used a pry tool to do it.

- We used the pry tool to take off the LCD screen. It had the same black sealant/adhesive on the back panel

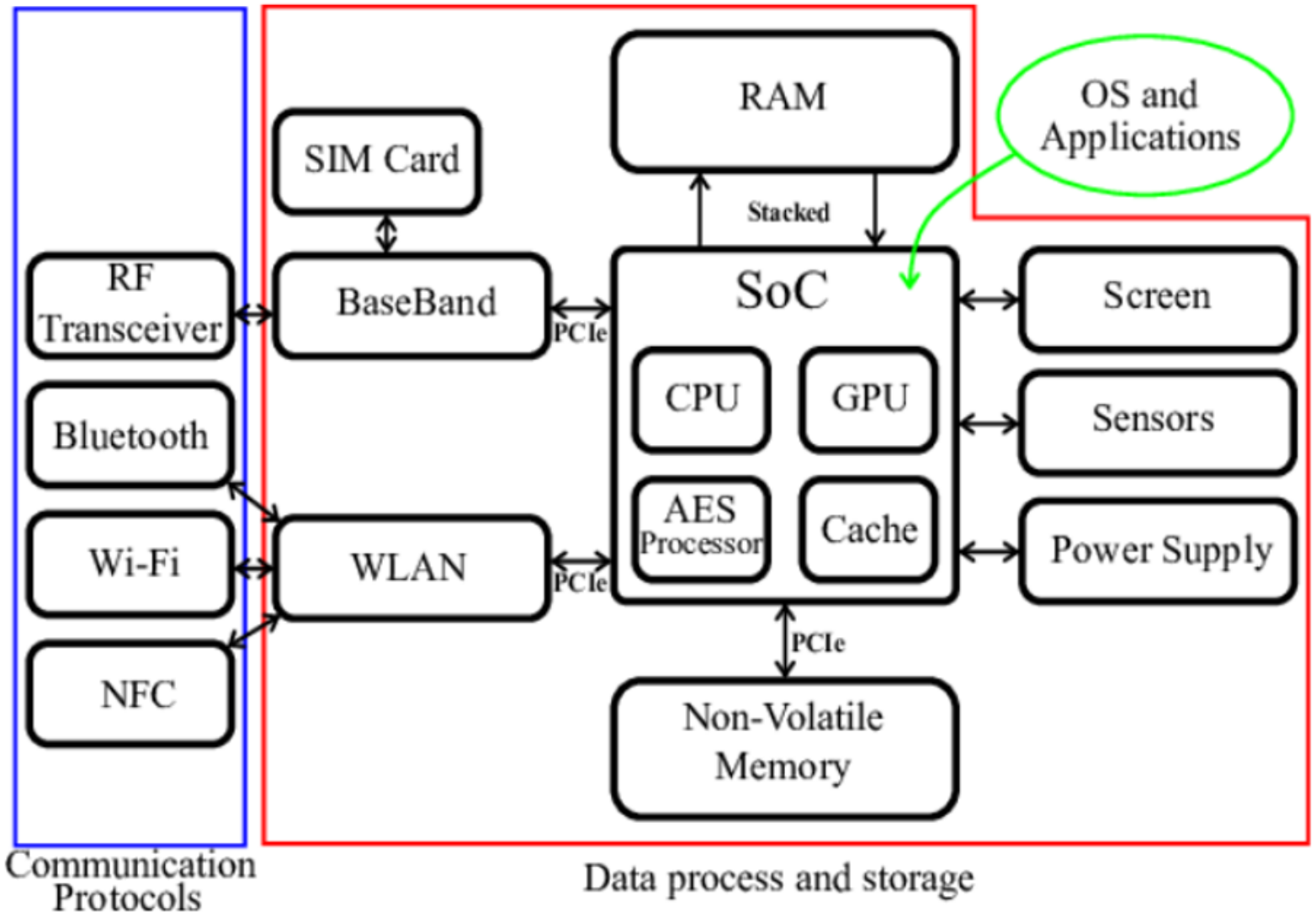
- The BTB connector on the back was the connection to the screen.

- After observing, we found all the individual layers of the LCD screen

*The screen of a phone consists of several overlapping each one playing a different role. (We will talk about this further)*

# ANALYSIS & DOCUMENTATION

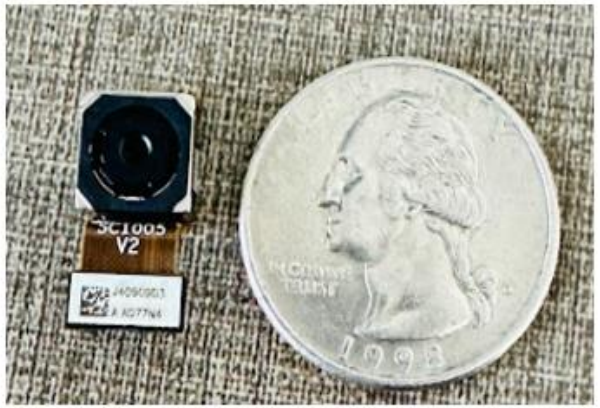
## BLOCK DIAGRAM




This is an Architecture/Block diagram about the parts of a smartphone, their functions, and their groups. This is to help us in analyzing our dismantled phone

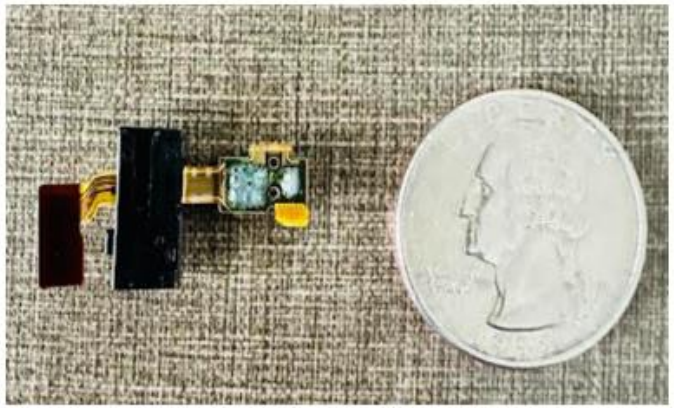
# ANALYSIS & DOCUMENTATION

## COMPONENTS



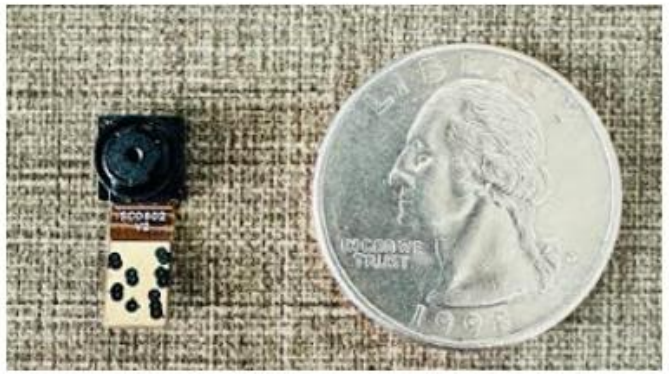

### BACK CAMERA

- 13 Mega Pixels (MP)
- Dual LED Flash
- 1080p at 30fps



### HEADPHONE JACK AND VIBRATION MOTOR

- 3.5 mm Jack
- As marked on the motor, 47 Hz



### FRONT CAMERA

- 5 Mega Pixels
- 22mm wide

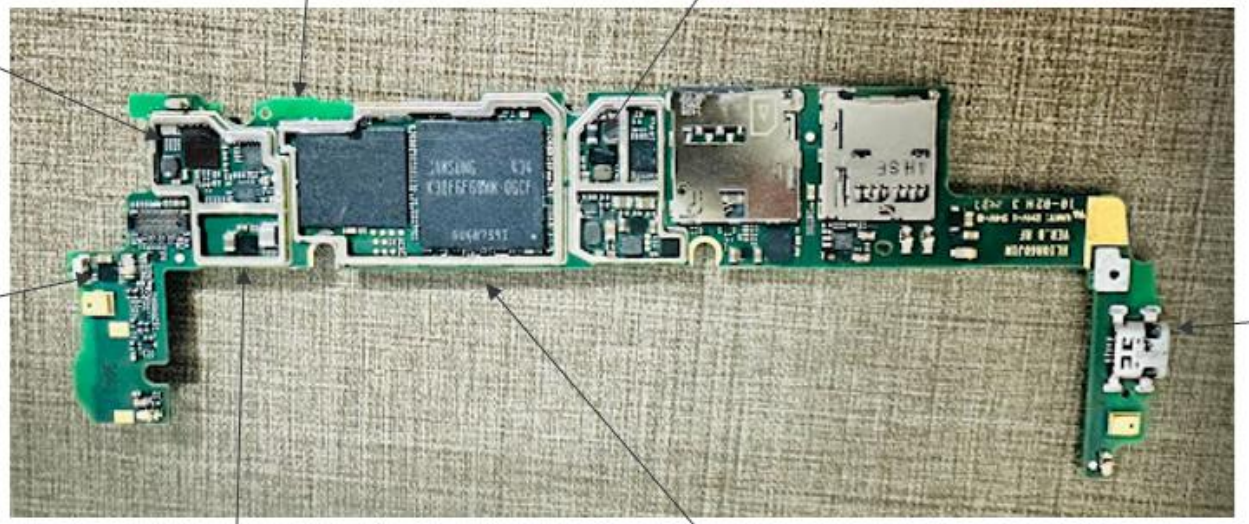
# ANALYSIS & DOCUMENTATION

## MOTHERBOARD LABELED

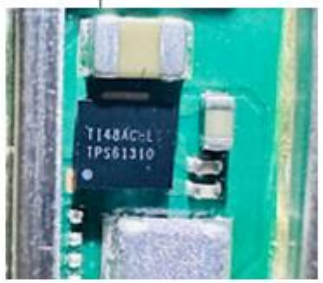
Broadcom BCM4334
Wi-Fi Radio , Bluetooth
receiver

SAMSUNG
KLMAG2GEA
C-B001
Memory/RAM

HiSilicon Hi6561
Power
Management Chip

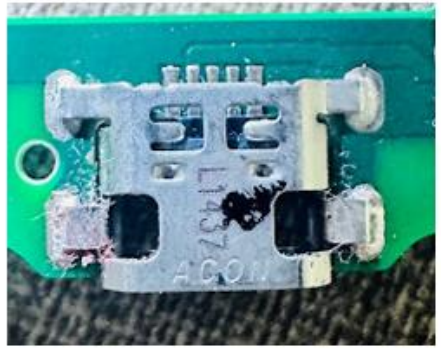


MAXQ616
Infrared Remote-Control
System and transmitter



TPS 61310
Texas Instrument LED
camera Flash Driver

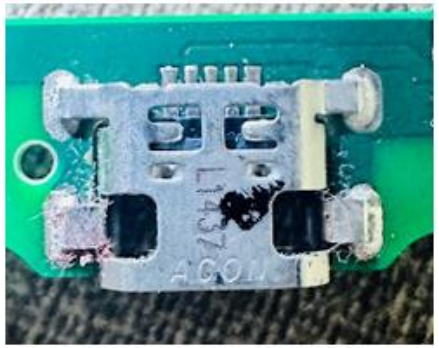
SAMSUNG K30F6F60MM-0GCF
Central Processing Unit



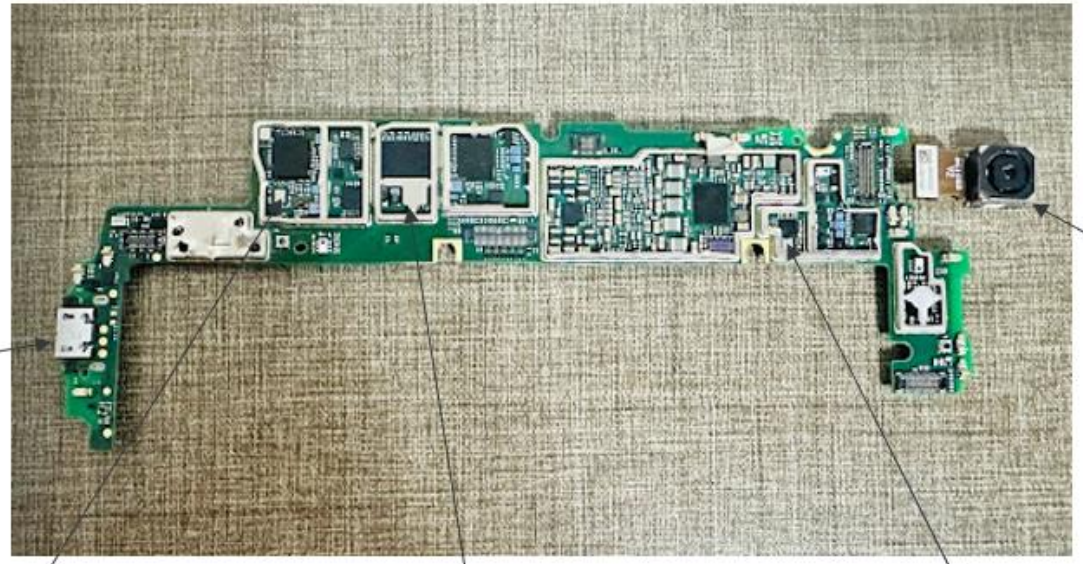
Micro USB data cable
port

# ANALYSIS & DOCUMENTATION

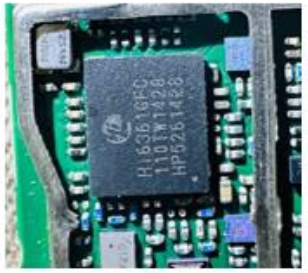
## MOTHERBOARD LABELED 2



Micro USB data cable port



Back camera



HiSilicon Hi6361GFC RF module chip


TriQuint TQP9058H power amplifier chip Multi-Mode/Multi-Band Power Amplifier Module


Broadcom BCM4752 WB2g Integrated Multi-Constellation GN SS Receiver

# ANALYSIS & DOCUMENTATION

## MOTHERBOARD PARTS

| Part | Description |
| --- | --- |
| MAXQ616<br>Infrared Remote-Control System and transmitter | The MAXQ616 is an Infared remote control system/transmitter designed for implications like consumer electronics and worldwide remote controls. The device combines a microcontroller and external devices like a universal receiver-transmitter, along with an IR module with frequency generation. |
| SAMSUNG KLMAG2GEAC-B001<br>Memory/RAM | The RAM of this phone is a Samsung 16GB chip. RAM, in its full form Random Access Memory, is a feature in most devices that allows is to store and access data temporarily and quickly. It Is much faster to read from and write. |
| Micro USB data cable port | A post at the bottom of the smartphone, that is designed to connect micro-USBs to compact devices like a smartphone. |
| SAMSUNG K30F6F60MM-0GCF<br>Central Processing Unit | This is the CPU of the phone. It is an Octa core, and the chipset is a Kirin 920. Its OS is an Android 4.4.2 Kit-kat or 6.0 Marshmallow. |

# ANALYSIS & DOCUMENTATION

## MOTHERBOARD PARTS

| Part | Description |
| --- | --- |
| TPS 61310<br>Texas Instrument LED camera Flash Driver | The flash driver, TPS61310 drives up two-three LEDs for flash strobe and video lighting implementations. It is based on a synchronous boost topology, which delivers high output current in synchronous switches. It has combining current sinks to |
| HiSilicon Hi6561<br>Power Management Chip | This is a Power management chip that provides a simple way to measure the devices battery spending. With smartphones having lots of new features, this is very essential, as it predicts the devices |
| Broadcom BCM4334<br>Wi-Fi Radio , Bluetooth receiver | The BCM4334X is a device that has several features like a Bluetooth and radio receiver. The BCM4334X is designed to address mobile devices requiring reduced battery consumption and a compact size. It includes a power management unit that simplifies the systems power management. |

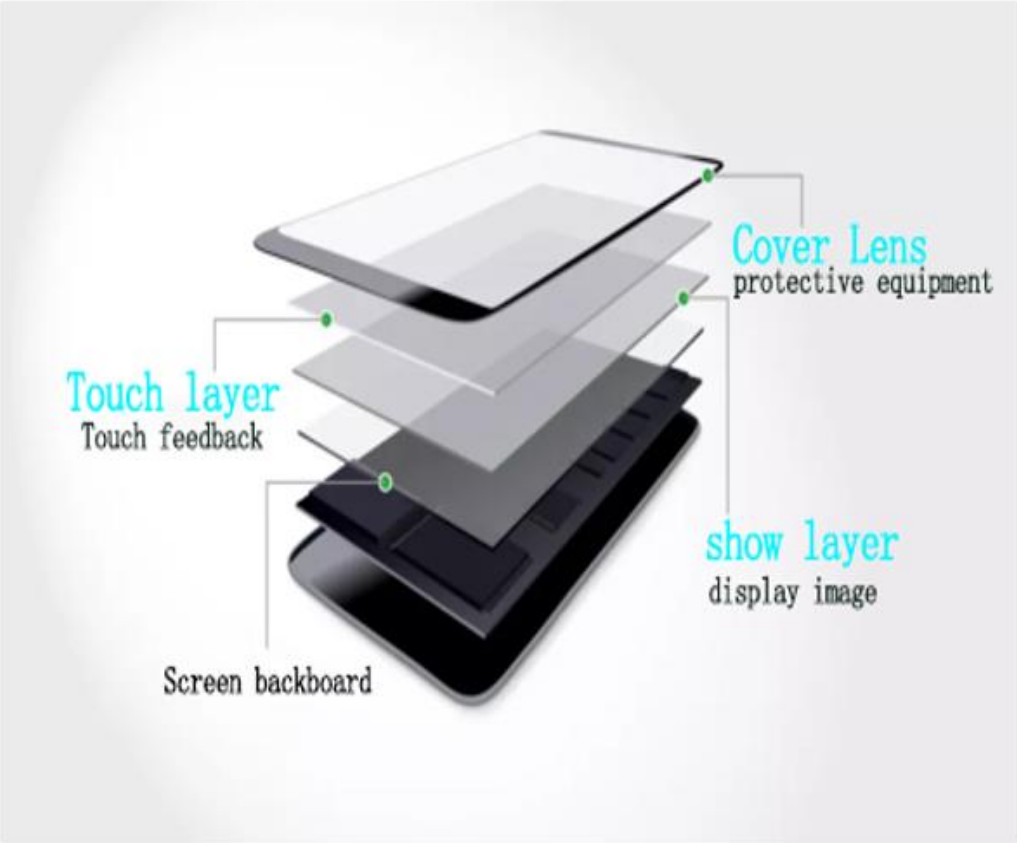
# ANALYSIS & DOCUMENTATION

## MOTHERBOARD PARTS

| Part | Description |
| --- | --- |
| HiSilicon Hi6361GFC<br>RF module chip | The RF chip is capable of radio frequency actions, and power amplification. It is a small device that connects to and transmits/receives data from other devices. This allows our phones to connect with other electronics. |
| TriQuint TQP9058H power amplifier chip<br>Multi-Mode/Multi-Band Power Amplifier Module | The TQP9058H is a multiband Power Amplifier Module. The output power is controlled by the VRAMP coming from the transceiver, which is a type of up-and-down variation of current. It also includes a coupler and built-in regulator, which is very helpful for small and compact phones. |
| Broadcom BCM4752 WB2g Integrated Multi-Constellation GNSS Receiver | The BCM47531 is the second provides multi-constellation support for GPS, BDS, etc. It offers , accurate real-time navigation, fast rerouting of signals after a blockage, and more. This receiver chip continues the ability to have low power consumption even with the ability to receive from for many satellites. |

# ANALYSIS & DOCUMENTATION

## LCD SCREEN



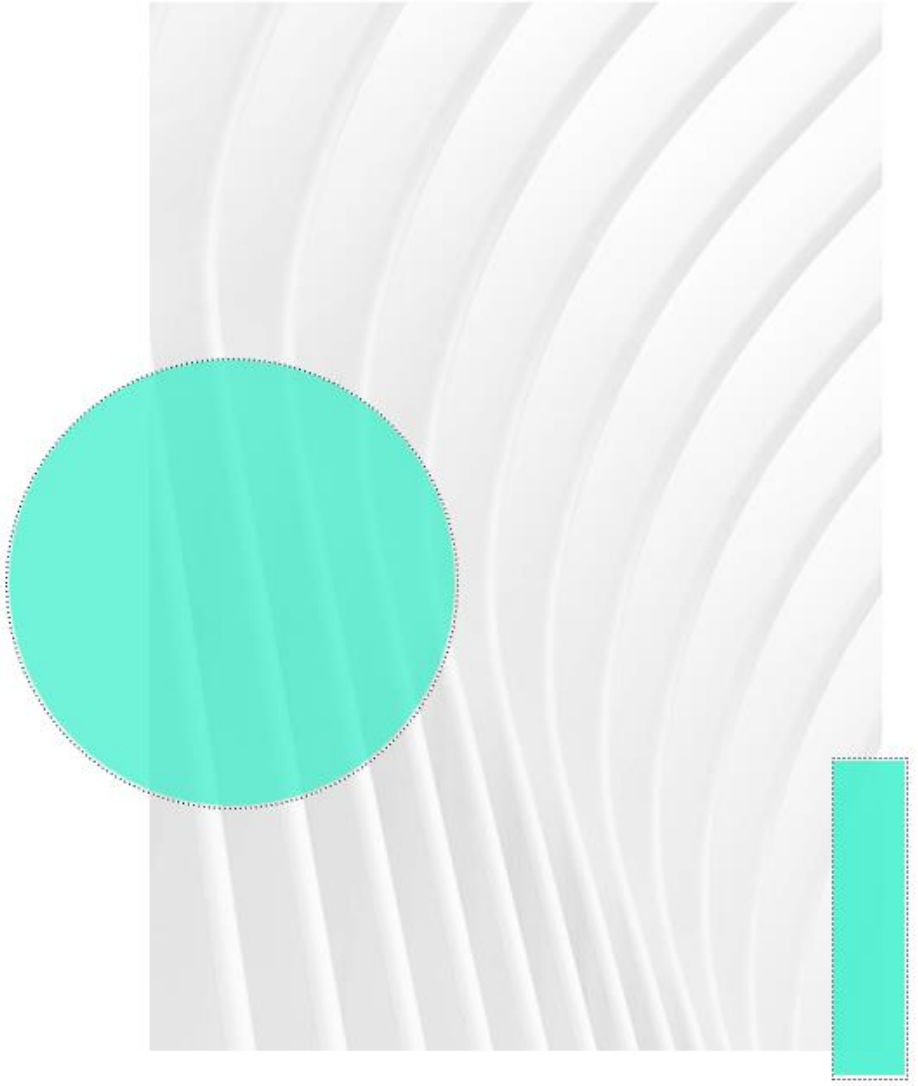

LCD screens (Liquid Crystal Display) has several layers, which are:

- Backlight (Provides a light source)
- Upper and lower polarizer (a light filter that blocks out unwanted light waves),
- Liquid crystal layer (controls the projection of light),
- Color filter (creates color in the screen by modifying light from the liquid crystal layer).

On the surface of the polarizer, there is most probably a touch layer, which enables for humans to interact with the screen. The layers mentioned are not singular and can have more than one. The figure depicted is an even more watered-down version of the layers.

# CONCLUSION

Dismantling the Huawei Honor 6 phone was very helpful to us, as it helped us understand many aspects of electronics, like how and where essential functions take place, important hardware and software components, and even how peripheral sensors can affect a device. We think that not only has this improved our understanding in smartphones or other devices, but also in robotics, helping us understand how the background functions of the brain, motors and sensors bring together our robot.



# SOURCES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- https://www.youtube.com/watch?v=FksuYIpuSPM
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