FINGERPRINT SENSOR

1.1 Model: GT521F32

1.2 Introduction:

       The GT521F32 fingerprint sensor is an optical sensor with a 258x202 pixel resolution. The sensor module has a 32-bit microcontroller based around the ARM Cortex M3 core processor to analyse the data. It is one chip fingerprint module designed for integration into products with UART interface.

1.3 Functional Block Diagram:

1.4 Interface Protocol:

    The GT521F32 fingerprint sensor primarily communicates with a host device using a simple UART protocol. This protocol involves the transmission of data packets, each containing specific information.

1.4.1 UART Introduction:

       UART, or Universal Asynchronous Receiver Transmitter, is a protocol used for asynchronous serial communication between devices. It typically involves two wires for communication: one for transmitting and the other for receiving data. UART is often implemented as part of an integrated circuit (IC) and is widely used for connecting microcontrollers, computers, and various peripheral devices due to its simplicity and effectiveness in data transfer.

1.4.2 Frame format:

- Start Bit: 1 start bit.
- Baud Rate: Typically set to 9600 bps.
- Data Bits: 8 bits per byte.
- Parity: None.
- Stop Bits: 1/2 stop bit.

1.4.3 Pros of UART:

- It is having less physical interfacing based on only two lines.
- Simple to configure data and data size. Speed is also configurable. In the majority of cases, this baud rate is 9600 for the UART protocol. Full duplex mode configuration is possible by using two wires so that is the major advantage of UART.
- Error detention is possible.

1.4.4 Cons of UART:

- UART is having serial communication, therefore, it has less speed.
- Start bit, stop bit, and the parity bit is other overhead.
- Since this is asynchronous communication so here there are many things that we need to do in configuration, for instance, we should configure both devices at the same speed because the clock signal is absent.

1.5 Features:

- ARM Cortex M3 Core CPU
- Maximum number of fingerprints stored is 200
- Communication interface is UART & USB 2.0
- Identification time is less than 1.5sec
- Matching mode:- 1:1 verification, 1:N Identification
- Resolution 450dpi(dots per inch)
- Wake up on finger function
- Ultra-thin Optical sensor
- Downloading fingerprint image from the device
- False Acceptance Rate(FAR) :- <0.001%
- False Rejection Rate(FRR) :- <0.1%
- Enrolment Time :- <3sec
- UART default baud rate is 9600 bps

- Size of template is 496 Bytes(template) + 2 Bytes(checksum)

1.6 Electrical Characteristics:

- Operating Voltage :- 3.3v to 6v
- Maximum operating current :- 130mA
- Transmitting serial data :- $V_{IL} = 0.8v$

$$V_{IH} = 2v$$

- Receiving serial data :- $V_{IL} = 0.8v$

$$V_{IH} = 2v$$

Where IL = maximum input low voltage

IH = maximum input high voltage.

1.7 Working of GT-521F32 Sensor:

- When a finger is placed on the sensor, it flashes a bright light over the finger to capture the digital image of the fingerprint using image sensor. The sensor has a resolution of 450dpi and an image size of 258x202 pixels.
- The captured image is processed by an onboard 32-bit microcontroller based on ARM cortex M3 core. This microcontroller analyses the fingerprint image by converting it into a series of 0's and 1's, representing the unique ridges and valleys of the fingerprint.
- The processed data is then used to create a fingerprint template. This template is a digital representation of the fingerprint, which can be stored and used for future comparisons.

1.8 Applications:

1. Access Control Systems

   i. Door Locks: Used in smart locks for residential, office, and industrial applications.
   ii. Secure Entry Systems: Enables biometric access control in high-security areas like data centres, labs, or government facilities.
   iii. Attendance Systems: Used for employee attendance tracking in offices.

2. Consumer Electronics

i. Smart Devices: Incorporated in devices like smartphones, tablets, and laptops for secure user authentication.

ii. Home Automation: Facilitates fingerprint-based control of smart home appliances.

3. Banking and Finance

i. ATM Security: Enhances security for ATMs by requiring fingerprint verification for transactions.

ii. Secure Payments: Used in point-of-sale (POS) systems or payment terminals for biometric authentication.

4. IoT Devices

Provides an additional layer of security for connected devices in IoT ecosystems, preventing unauthorized access.

5. Health Care

i. Patient Identification: Used in hospitals to ensure accurate patient identification and record management.

ii. Medical Device Security: Prevents unauthorized usage of sensitive medical equipment.

References:-

- GT-521F32 datasheet , Link:- http://www.adh-tech.com.tw/files/GT-521F%20Series_datasheet_V1.6.pdf.
- GT-521F32 Programming Guide, Link:- GTM Series.