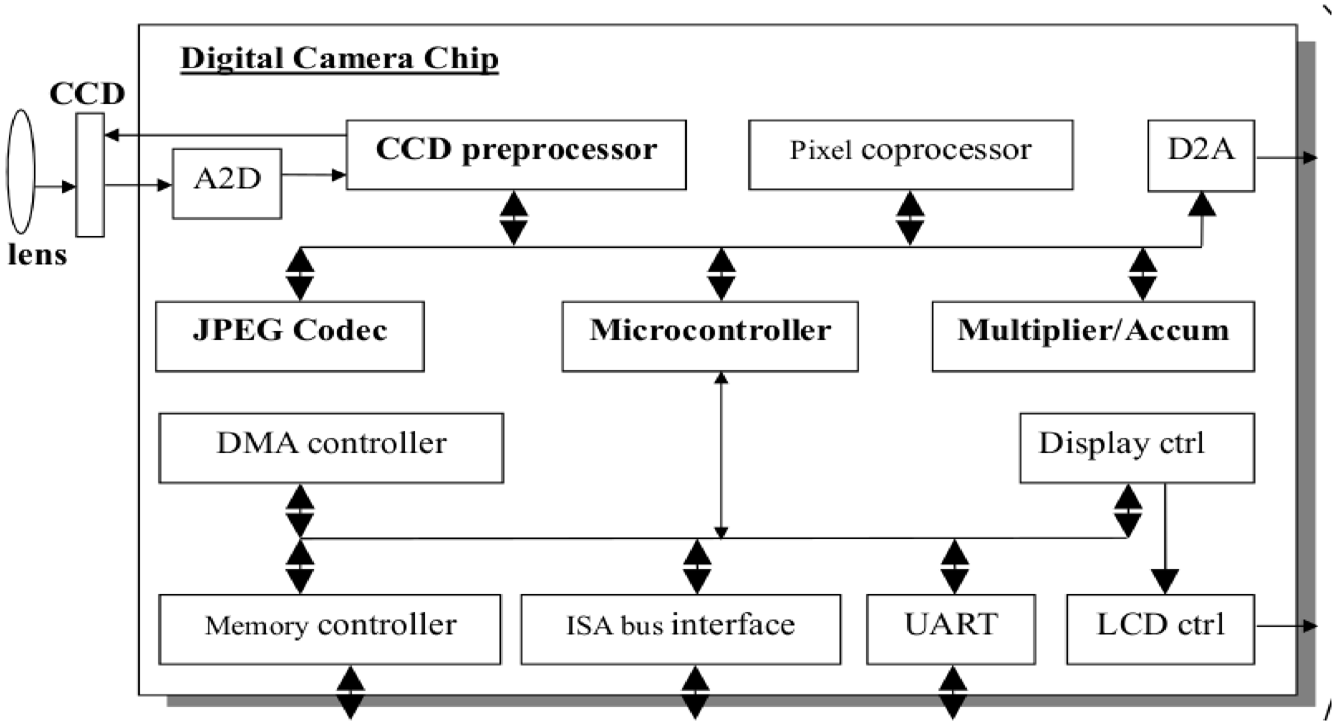
Digital Camera:

- Digital Camera is an example of Stand-alone Embedded system.
- Digital Camera is used to capture, store and represent the image in digital format.
- Digital Cameras analyze the images and able to detect humans, motion, faces etc.. from the whole image it captured.
- Digital camera consists of Image Sensor, Image Processor,Microcontroller, ADC (Analog to Digital Convertor) ,DAC(Digital to Analog Convertor), Memory, Lens, LCD, Timer, USB port.
- **CCD** (Charged-coupled Device) is a special sensor that captures the image, it is capable of converting input light into electrical signal.
- **ADC** converts the captured image into digital format.
- **Digital Signal Processor** processes the image taken by CCD camera after converting into digital format.
- **Co-processor** in tha camera is mainly meant to compress and decompose image.
- **Microcontroller** is used to interconnect all the components and performs the operations.
- Digital Camera has various types of **memories** like DRAM, Memory card, and Flash memory etc...
- **Timer** in the Digital Camera is used to synchronize all the components and for displaying purpose.
- **Keys** act as input to the Digital Camera through which the user can interact.
- **LCD** acts as output where the images are displayed on the screen.
- **USB** port provides the serial communication between the Digital camera and the device connected to it.
- Digital Camera even has **Bluetooth** connection, which also provides serial communication.

Block Diagram of Digital Camera:



UART Module

- Half UART module in Digital Camera transmits images but not receive
- UartInitialize function is used to pass the file name
- UartSend function is used to tranmit the image

Code:

```
#include<stdio.h>
static FILE outputFileHandle;
void UartInitialize (const char outputFileName) {
    outputFileHandle = fopen(outputFileName, “w”);
}
void UartSend (char d) {
    fprintf ( outputFileHandle, “%i\n”, int d);
}
```

CCD Module:

- CcdCapture function is to read image from file
- CcdInitialize function is to pass name of image file

Code:

```
#include <stdio.h>
#define SZ_ROW      64
#define SZ_COL       (64+2)
static FILE imageFileHandle;
static char;
buffer [SZ_ROW][SZ_COL];
static unsigned rowIndex,colIndex;

void CcdInitialize ( const char imagrFileName) {
    imageFileHandle = fopen (imageFilename, “r”);
}

void CcdCapture (void){
int pixel;
for (rowIndex=0; rowIndex<SZ_ROW; rowIndex++){
 for(colIndex=0; colIndex<SZ_COL; colIndex++){
   if (fscanf (imageFileHandle, “%i”, &pixel)==1){
      buffer [rowIndex] [colIndex] = pixel;
}}}
rowIndex =0;
colIndex =0;
}
```

Coding Standards of ‘C’ programing languages

1. All programs shall be written to compile with the C99 version of the ISOC Programming Language Standard.

2. **Line Width** - The width of all lines in a program shall be limited to a maximum of 80 characters.

3. **Braces -** Braces shall always surround the blocks of code. Single statements and empty statements following these keywords shall always be surrounded by braces.

Ex:- if, else,switch,while,do, and for statements

4. **Parentheses** – Unless it is a single identifier or constant, each operand of the logical AND (&&) or logical OR (||) operators shall be surrounded by parentheses.

5. The comments in C language are written as **“/* ......*/”** or preceded by **“//” .**

6. **Spaces** :- The following operators are preceded and followed by one space.

- Each of the keyword if,else,while,for,switch and return
- Each of Assignment operators =,+=,-=,*=,/=,%=,&=,|=,^=,!=
- Each of binary operators +,-,*,/,%,<,>,<=,>=,==,!=,<<,>>,&,|,^,&&,||,
- Each of Unary operators +,-,++,--,!,~
- The pointer operators *,&
- The ternary operators ?,:

7. **Blank Lines –** There shall be a blank line before and after each natural block of code.

8. **Indentation -** Whenever a line of code is too long to fit within the maximum line width, indent the second and subsequent lines in the readable manner.

9. **Tabs –** The tab character shall never appear within any source code file.

10. **Naming Convention –** All module names consists of lowercase letters,numbers and underscore. No space shall appear within module name.

- Keywords are not considered as name of functions
  Ex- interrupt,class,true,false,public,private,protected
- All Variables should be initialised before use.
- Variables shouldn’t overlap functions in standard library
  Ex- strlen,memset
- No variable is longer than 31 characters

11. **Signed and Unsigned Integers –** Signed integers shall not be combined with Unsigned integers in comparision or expressions.

12. **Functions -**

- The length of each function is limited to 100 lines, if possible can fit in a page.
- All functions should have just 1 exit point
  Ex- return
- All functions that encapsulate threads of execution shall end with “_thread”.

13. **Jumps -**

- Use of goto statement is restricted
- C Standard Library Functions such as abort(), exit(), setjmp(), longjmp() are not used.

14. **Equivalence Test -** When evaluating the equality of a variable against a constant, the constant is always placed left to the “=” operator.