AN OVERVIEW SMART ASSISTANT SYSTEM FOR OLD PEOPLE USING INTERNET OF THINGS

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Abstract **- The Internet of Things is a technology that applied in the field of healthcare, especially elderly patients, and allows patients to be tracked without the need for direct physical interaction with patients. Diseases and other consequences can be recognized early, especially those who are more likely to have a disorder in their physiological data. It is critically necessary to create new approaches and technology in order to improve health care for the aged population at a price that is more cheap and in a form that is simpler to use. In addition, patients and members of their families get a sense of peace when they are aware that they are being observed and will be assisted in the event that any complications emerge. This study uses a literature review to explore the ideas behind healthcare system components, in addition this study examines the characteristics, requirements, and definitions of internet of things. The primary purpose of this study is to introduce the reader to the various sensors and other healthcare system components utilised for the purpose of monitoring the elderly. However, this work will help future researchers who desire to do study in this field of healthcare systems and assist efficient knowledge acquisition by providing a solid foundation.**

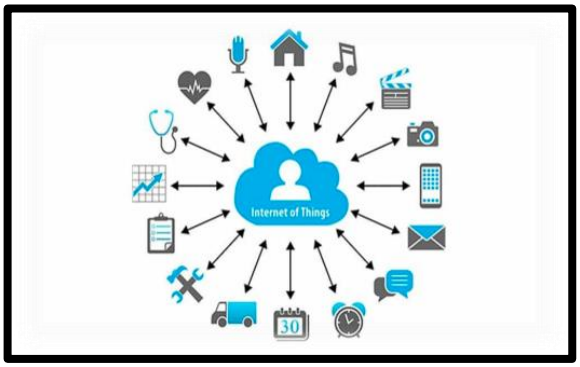
Index Terms - IoT, ESP32, Health monitoring, Sensors, GPS

I. INTRODUCTION

Since the beginning of the century, internet of things (IoT) technology owns a significant impact on many facets of human life, especially in the domains of medicine, industry, transportation, education, and farming. This technological advancement makes use of sensors or actuators to comprehend the condition of the environment around it. The majority of them connected through various communication technologies such as Wi-Fi and Global System for Mobile (GSM) in order to communicate with control centers and send data acquired from the environment, as well as to assist in the process of decision-making at distant control centers [1]. Health care has come a long way in the last century, and that is helped people live longer, so Global health has been profoundly affected by the widespread adoption of mobile technology and smart devices. Experts in the medical field are increasingly capitalizing on these technologies' advantages, leading to vast enhancements in patient care, In the same way a large number of regular users are currently benefiting from the advantages offered by M-Health (Mobile Health) applications and E-Health (health care assisted by information and communication technology in order to enhance, help, and assist their own personal health [2] .

A. Internet of Things

The Internet of Things (IoT) is a network which is composed of physical objects (devices, vehicles, home machines, and a variety of other things that are outfitted with specialized hardware, sensors, and actuators). These things are connected to one another via the internet, which enables them to share data, This opens the door to the possibility of a more direct integration and reconciliation of the physical world into systems based on personal computers, which results in increased efficiency, increased economic rewards, and less human labor [3] . The Internet of Things (IoT) refers to a technology that permits a large number of connected devices, each of which is tasked with the job of gathering, reading, and then transferring immense volumes of data via the internet for a wide range of applications. The Internet of Things has built connections with a wide variety of companies, including home automation, smart home networks, manufacturing, security systems, healthcare, data management and analysis, military transport systems, and sensors [4]. The Internet of Medical Things, commonly referred to as IoMT, is the part of the (IoT) that is programmed for collecting and analyzing data for the aim of testing and monitoring. [5]. The term "Smart Healthcare" refers to the infrastructure that permits the construction of a digitised health care system which links available patient information and healthcare services, this name was given to it because of its ability to make healthcare more efficient. Only with the expansion of IoT is remote patient monitoring currently conceivable, Whereas Wearable sensors to complex devices are examples of health monitoring kits. According to a recent study, there are approximately one-third of the Internet of Things (IoT) devices in the medical field, and analysts project that this number will increase by 2025, showing that our



health sector is becoming more digitalized [6], Figure (1) shows the uses of the Internet of Things in the fields of life.

Fig1. Internet of Things.

B. IoT In Healthcare

The Internet of Things' use in the healthcare monitoring system has allowed us to make great strides in the improvement of medical care in the modern day. The sensors have reduced in size as a direct result of developments in very large-scale integration (VLSI) technology, which has paved the way for the creation of wearable solutions, The devices are getting more powerful and efficient as a direct result of their continual connectivity to the internet. Health monitoring devices based on the Internet of Things track a patient around the clock, by doing statistical analysis devices are able to at any vital moment, generate the required information. Due to the fact that devices based on the Internet of Things are always connected to the internet, patients may be remotely monitored, and in the event of an emergency the appropriate actions can be done. Therefore, devices based on the Internet of Things are able to provide detection as well as emergency response service [7]. The Internet of Things (IoT) is being used in the medical profession to check patients' health, Therefore There are two types of medical sensors: implantable and wearable. Wearable sensors allow for the monitoring of health indicators, temperature, calorie intake, and other metrics. While when a patient's condition requires continuous monitoring, surgically inserted sensors are the tools of choice. For example, a sensor implanted in the human body allows the doctor to track and monitor the patient's heartbeat, pulse rate, and other vital signs [6]. Sensors transmit data to doctors from far away, allowing them to continuously track vital signs (such as body temperature, blood pressure, heart rate, cholesterol level, and blood sugar level) [1], Figure (2) shows the applications of the Internet of Things in the field of healthcare.

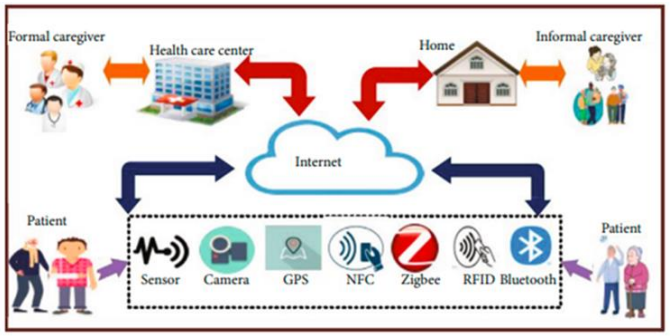


Fig 2. IOT applications in healthcare.

II. Literature Review

In 2017, Saranya, et al [8] , The authors employed a microchip wireless technology (Mi-Wi) to track Alzheimer's patients in a 100-meter safe zone. The system checks whether the patient is wearing the device or not using GPS, GSM, and heartbeat sensors embedded into the device, all controlled by a microcontroller (UNO) and a communication network. When the patient leaves the safe zone, a text message with the latitude and longitude data is sent to the caregiver's phone. To locate the patient, the carer could use Google Maps. The system's overall performance was simple to operate and inexpensive when compared to competing products.

In 2018, D. Shiva Rama and S. Chand et. al, [9] The authors presented an innovative initiative for reducing such rates of unexpected death through the use of Patient Health Monitoring, which uses sensor technology and the internet to communicate with loved ones in the event of an emergency. This device monitors the patient's health by using a heartbeat and temperature sensor. The two sensors are linked using an Arduino-Uno. The microcontroller is connected to a Wi-Fi adapter and an LCD screen so that data can be transmitted to a web server (i.e., the wireless sensing node) and used to monitor the patient's condition. If a patient's temperature or pulse rate suddenly fluctuates, a warning can be sent using the Internet of Things. This technology also displayed the patients' temperatures and heartbeats in real time with timestamps through the Internet.

In 2018, C. Senthamilarasi et al, [5], The authors propose a mobile device-based approach for monitoring health concerns. Which can deliver online real-time information regarding the physiological state of the patient. It primarily includes sensors, a data acquisition module, a microcontroller (e.g., Arduino), and software (e.g., JAVA). Patient temperature, heart rate, and electroencephalogram (EEG) data They are monitored, presented, and saved by the system before being sent to the doctor's mobile phone, which has Request.

In 2018, Mehmet Tastan [10], The authors created an android-based software that can track the values of Heart Rate (HR), Heart Rate Variability (HRV), and Body Temperature (BT) for cardio-vascular patients that require continuous monitoring. The patient's health indicators are continuously monitored by the measuring system, which consists of wearing sensors. Then, the android interface receives the signals via wireless transmission. When established critical values for a patient are exceeded, HR, CT, and HRV data, as well as the patient's real-time location, are conveyed to the doctor and family members via Twitter notifications and emails. The wearable measurement device allows patients to be mobile in their social situations, allowing them to live their lives with more confidence.

In 2019, Vaibhav Wasekar and Shweta Gajbhiye et. al.[11] , The authors propose a method for automatically monitoring an individual's health status, such as heart failure, high blood pressure, and diabetes, using sensors. A variety of sensors would be used to collect a person's biological information in this case, following that, data will be sent to the IoT. This technology can detect the patient's serious condition. The analysis is carried out on data acquired from patients of various ages, such as 20-30, 30-40, 40-50, and so on. This information has been represented graphically; the graph will comprise data from several age groups, with the mean value of the biological

information in every age group, it will be different in women than in men. A modern concept like remotely monitoring patients could lead to major advancements in the medical industry.

In 2022, Athiya Meraj Pathan et al [3] The authors create an intelligent health monitoring system that uses IOT to automatically monitor the patient's heart rate, temperature, electrocardiogram (ECG), and other parameters. Vibration transmits an emergency alarm to the patient's doctor, including his present condition and complete medical information. This would allow the doctor to track his patient from anywhere, as well as the patient to send his health condition without having to attend the hospital. The suggested system's principal goal was to deliver better and more effective health services to patients by creating a networked information cloud that experts and doctors could use to provide a quick and efficient solution. The final model is well-equipped with capabilities that allow the doctor to look over his patient from any place and at any time. In an emergency, send an emergency message or email to the doctor detailing the patient's present condition and full medical history.

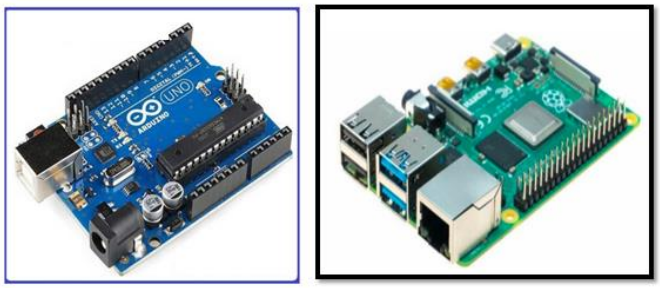
III. IoT Components used in Healthcare Devices

A. *Microcontrollers*

A microcontroller is an embedded system, which means a computer system designed to do certain functions (for example, engine control units, medical devices that are implanted, tools, etc.). Different microcontrollers are usually made with different sizes, functions, features, software architectures, power requirements, amount of input/output (I/O) pins that can be used, processing speeds, etc. [12]. The microcontroller is the brain of the development board, it acts like a tiny computer and can send and receive information or commands from the other devices that are connected to it. From board to board, the processor is different, and it also has different specifications. Many different kinds of microcontrollers are readily accessible for programming, erasing, and reprogramming at any time [13]. The most common varieties of microcontrollers will be covered here:

1) Arduino: It is electronic devices with an open-source design that can read inputs, a finger on a button or a light shining on a sensor are both examples, as well as creating output (such as turning on a light-emitting diode (LED) or starting a motor, for example). An Arduino board is a microcontroller, which is a type of non-full computer that runs on its own operating system, similar to Raspberry Pi [14].

2) Raspberry Pi : The Raspberry Pi is a computer with a single board that is developed and produced in the U.K. by the Raspberry Pi Foundation ("Raspberry Pi,"). In comparison to other similar devices, the Raspberry Pi is both powerful and inexpensive. It's great for use in any form of embedded system or robotics project [15].



(a) Arduino Uno (b) a Raspberry Pi (b) a Raspb

Fig 3. (a, b) Arduino Uno & Raspberry Pi.

Table 1 provides an explanation of the most significant differences between Arduino and Raspberry Pi.

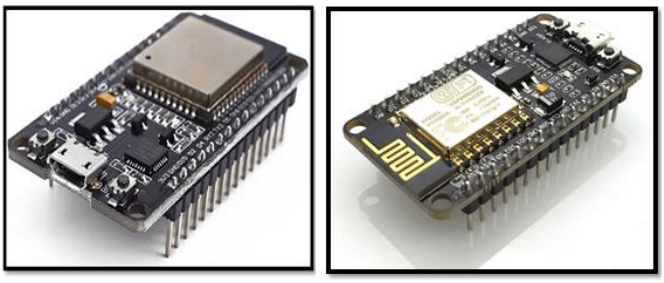
TABLE I.
DIFFERENCES BETWEEN ARDUINO AND RASPBERRY PI [14], [9]

Basis	Arduino	Raspberry Pi
License	Arduino is a project that uses open-source software. The source code for both the software and the hardware design is open source	Raspberry Pi is a closed source project in both its hardware and software forms.
Control Unit	From Atmega Family	From ARM Family
Clock Frequency	16 MHz (Arduino UNO)	700 MHZ
RAM	Requires less RAM (2kB)	Requires large RAM (more than 1 GB)
CPU	8-bit	64-bit
The Logic level	The logic level of an Arduino is 5V.	The logic level of the Raspberry Pi is 3V.
The Power Consumption	The power consumes around 200 MW	The power consumes around 700 MW
Based on	Microcontroller	microprocessor

The Hardware Structure	Simple hardware design	Complex hardware design
Software	(C/C++ languages)	support its own Linux-based operating system. You can also install any OS you choose.
Internet	without internet support. or add additional device or shield to connect with internet.	Raspberry Pi comes equipped with both Wi-Fi and an Ethernet connection.
The Cost	cheaper	expensive
Handle a loss of power	When an Arduino gadget is turned on, it begins executing code. As a result, if the power is quickly cut off, you will not have a corrupt operating system or faults. When plugged in, the code simply restarts.	Raspberry Pi needs the same attention as a computer. must be properly shut down.
(The current drive strength)	High	Lower
(Capability)	In most cases, Arduino is used to repeatedly carry out a single (and quite simple) activity.	The Raspberry Pi can handle numerous tasks at once.
Wireless connectivity	Neither Bluetooth nor Wi-Fi are supported by Arduino.	has both Wi-Fi and Bluetooth
Applications	Timer for traffic lights, parking lot counters, weighing devices, etc.	The use of stop-motion cameras, game server, robot controllers, etc.
Size	(7.6*1.9*6.4) cm	(8.5*5.6*1.7) cm
GPIO	14(Arduino UNO)	40

3) *Espressif System (ESP32 Processor):* The ESP32 is a popular IoT learning tool. The ESP32 uses general purpose input/output (GPIO) pins to connect device sensors and actuators. ESP32 and IoT combine to form a new technology for healthcare creativity. The EPS32 is capable of communicating with other Bluetooth and Wi-Fi devices [16], It is also features a two core CPU operating at 160 MHz and an ultra-low power co-processor. It was developed as a solution for the inadequate security that was present in ESP8266 [17], It is also developed specifically for use in wearable electronics and Internet of Things applications [18].

4) *Espressif System (ESP 8266) :* The ESP 8266 is a low-cost, high-performance System on Chip Wi-Fi to serial module that is part of Espressif System's 'Smart Connectivity Platform,' which seeks to enable mobile platform designers with the ability to build products with embedded Wi-Fi capabilities at the lowest cost while providing the greatest functionality [19]. In contrast to the ESP32, the ESP8266 lacks Bluetooth connectivity. Compared to the ESP32, the GPIO on the ESP8266 is extremely limited. The ESP8266 is a Wi-Fi Soc system-on-a-chip that has all the necessary parts for a working Wi-Fi device [20].



(a) ESP32 Processor **(b) ESP 8266**

Fig (4. a, b) ESP32 & ESP 8266 Processor

Table 2 provides an explanation of the most significant differences between ESP32 and ESP8266.

TABLE II.
COMPARISON TABLE BETWEEN ESP32 VS ESP8266 [21], [18]

Comparison	ESP32	ESP8266
Clock Frequency	160 or 240MHZ	80 MHZ
Bluetooth	Yes	No
WI-FI	Yes	Yes
Hall Sensor	Yes	No
Camera Interface	No	No
Touch Sensor	10	No
Security	Security Boot flash encryption. OTP 1024-bit	No
Low Power Consumption	10uA deep sensor	20uA
Working Temp.(◦C)	-40 to 125	-40 to +125
Co-Processor	ULP	No
Total GPIO	39	17
Crypto	RSA, RNG, ECC, SHA-2, AES	No
SPI	4	2
USB OTG	No	No
Microcontroller	Single or dual-core 32-bit LX6 Xtensa	Single core 32-bit L106 Xtensa
ROM	448 KB	No
CAN	2	No
Ethernet	10/100 Mbps	No
SRAM	512 Kbytes	160kBytes
ADC	12 BITS	10 BITS

Table 3 provides an explanation of the most significant differences between ESP32, ESP8266 and Arduino.

TABLE III
COMPARISON TABLE BETWEEN ESP32, ESP8266 AND ARDUINO [22]

SPECS/BOARD	ESP 32	ESP 8266	ARDUINO UNO
Number of Cores	2	1	1
Architecture	32 BITS	32 BITS	8 BITS
CPU Frequency	160 MHZ	80 MHZ	16 MHZ
WIFI	YES	YES	NO
Bluetooth	YES	NO	NO
Ram	512 KB	160 KB	2 KB
Flash	16 MB	16 MB	32 KB
GPIO Pins	36	17	14
Busses	SPL,12 C, UART, 12 S, CAN	SPL,12 C, UART, 12 S,	SPL, 12 C, UART
ADC Pins	18	1	6
DAC Pins	2	0	0

B. The Sensors:

Sensors are described as modules that detect or measure a physical property and record, indicate, or respond to it. There are many different types of sensors, including motion or (motion processing unit), Global positioning system (GPS) unit for determining geographical location, temperatures, heart rate sensors, Saturation of Peripheral Oxygen (SPO2) sensor, etc.

1) Temperature-Sensor: Maintaining a healthy body temperature is essential because catalysing chemical reactions is the responsibility of enzymes in body cells, and these enzymes must have the proper temperature to accomplish this task. Temperature-Sensor obtains instantaneous information about body temperature, which it translates into electronic data. Temperature sensors are used to record or monitor temperature changes. Temperature sensors are classified into numerous categories [23].Prepare your paper in full-size format on US letter size paper (8.5 by 11 inches).

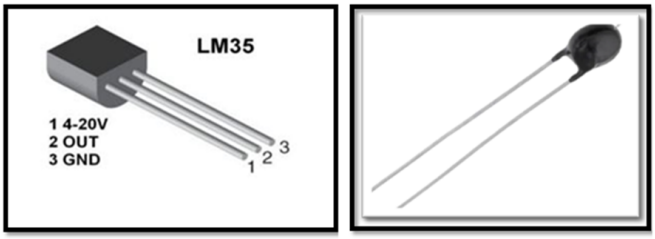
i. Linear Model Sensor (LM-35)

Temperature sensors in the LM35 series are accurate integrated circuits whose output voltage is directly linked to the temperature in Celsius (Centigrade). The LM35 sensor is better than a linear temperature sensor because the user doesn't have to figure out how to change the temperature

from Kelvin to Centigrade [24]. LM35 Sensor Specifications:
-The range of temperatures that can be measured is from -55°C to 150°C.
-Drain power is less than 60A.
-Accuracy = 0.5°C
-The sensor is inexpensive.

ii. NTC Temperature Sensor (Negative Temperature Coefficient)

Thermistors are inexpensive, simple, and accurate components which make obtaining temperature data simple. Thermistors, also known as thermally sensitive resistors, are variable resistors whose resistance varies with temperature. NTCs are widely utilised as temperature sensors or as inrush current limiters in series with circuits such as power supply [25].



(a) Temperature Sensor-LM35 (b) Temperature Sensor-NTC

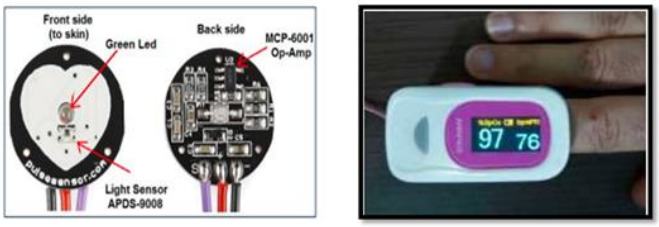
Figure (5. a, b) LM35 & NTC Sensor

2) Heartbeat Sensor

The heartbeat sensor was created using the plethysmography hypothesis. It detects the change in blood volume passing through anybody's organ that affects light intensity to pass through that organ. The pulse timing is more crucial in devices that track the heart rate, The rate of heartbeats influences the distribution of blood volume and signal pulses are equal to heartbeat pulses when light is ingested by the blood [16].

3) SPO2 sensor (Blood Oxygen Saturation)

Although the Spo2 sensor is incorporated into the heart rate sensor, it is comparable to a commercial pulse oximeter fingertip device, which is a highly frequent instrument in hospitals for measuring patients' Spo2. The percentage of hemoglobin molecules in arterial blood that are saturated with oxygen is measured as blood oxygen saturation. The readings from a pulse oximeter range from 0% to 100%. A normal healthy adult is going to have a reading between 95% and 100% [23].



(a) Heartbeat Sensor (b) Pulse oximeter fingertip device

Figure 6. (a, b) Heartbeat Sensor & Pulse oximeter fingertip device.

4) Heart Rate-SpO2 Sensor Module

i. MAX30100 (Maxim Integrated Circuit)

Is a sensor that can detect both the heart rate and the level of oxygen in the blood. The calculation for blood vessel oxygen saturation known as saturation of peripheral oxygen, or SpO2, refers to the amount of oxygenated hemoglobin that is present in the blood. The normal range for SpO2 levels in a person's body is generally between 90 and 100 percent [26].

ii. MAX30102 (Maxim Integrated Circuit)

Is a non-invasive optical device used for two major purposes: heartbeat detection and peripheral capillary oxygen saturation (Spo2) [23]. The MAX30102 device is an upgrade of the MAX30100 device, which provides infrared tracking of the heart rate, pulse, and blood oxygenation, allowing control over these activities in patients in need of particular care, and is mostly utilised in projects linked to human health [27].

(a)Pulse Sensor (MAX30100 (b)Pulse Sensor (MAX30102)

Figure 7. (a, b) MAX30100 & MAX30102

C. Global positioning system module (GPS)

The Global Positioning System (GPS) is an international system of satellites in Earth orbit used for navigation and other purposes on a global scale. These satellites continuously send signals to receivers on Earth, such as mobile phones, (GPS) in cars, or any other device or system that supports a (GPS) service, receive these signals, and the location of the receiver can be determined by combining three or more signals from different satellites [28].

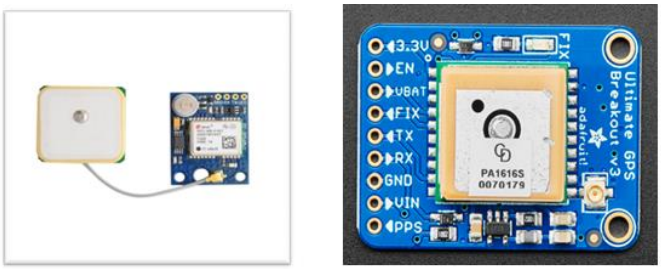
1) GPS module (NEO-8M)

The NEO-8 module GPS is a type of sensor that gives geographical location information. These adaptable and cost-effective receivers provide several connectivity choices in a small (16 12.2 2.4) mm size. It has a signal indication that helps to monitor the module's status. The red indicator continuously flashes, indicating that the module is in the search stage, but when it receives a reliable signal it turns off, and with its backup battery the module may save the data if the main power is accidently turned off [29].

2) The Adafruit Ultimate GPS

high-quality GPS module that can track up to twenty-two satellites simultaneously across 66 channels, with an outstanding high-sensitivity receiver (tracking sensitivity of -165 dBm) and comes with its own antenna. It can perform up to ten location updates per second for fast, high-sensitivity

logging or tracking. During navigation the power consumption is extremely low at only 20 mA. To save electricity the LED blinks at around 1Hz while looking for satellites and once every 15 seconds once a fix is found [30].



(a)The GPS Module with its Antenna(b)TheAdafruit Ultimate GPS

Fig 8. (a, b) The GPS Module with its Antenna & The Adafruit Ultimate GPS

Table 4 provides an explanation of the most significant differences between NEO-8M GPS and Adafruit Ultimate GPS module.

Table IV
Comparison Table Between NEO-8M GPS and Adafruit Ultimate GPS module [31], [32].

Parameters	NEO-8M GPS module	Adafruit Ultimate GPS
Receiver Type	50 channels	66 channels
Horizontal Position Accuracy	2.5m	1.8 m
Navigation Update Rate	1HZ (5Hz maximum)	1-
Capture Time	Cool start: 27s Hot start: 1s	Warm/cold start: 34 seconds
Navigation Sensitivity	-161dBm	-165 dBm
Serial Baud Rate	4800-230400 (default 9600)	NMEA 0183, 9600 baud default
Operating Voltage	2.7V ~ 3.6V	5V
Operating Current	45mA	20mA
Antenna	This module has an external antenna and built-in EEPROM.	built in antenna.
power consumption	by turning on and off subsets of the receiver's power supplies, system power consumption can be reduced.	Power usage is incredibly low
Updates	it can perform 5 location updates in a second with 2.5m horizontal position accuracy.	It can do up to 10 location updates a second for high speed, high sensitivity logging or tracking.
Patch Antenna Size	25mm x 25mm	15mm x 15mm x 4mm
Weight (not including coin cell or holder)	12 g	8.5g
the price	$15.00	$29.95

D. Display Unit

1) LCD Display (Liquid Crystal Display)

A liquid crystal display (LCD) is a type of display comprised of liquid and sold parts. It has a backlight as a light source in the rear of the screen. It also contains crystals, which serve as blockers and reflectors. It works in block mode by blocking light when the screen is turned off, and in reflect mode by reflecting light when the screen is turned on. LCDs come in a variety of shapes and sizes and are utilized in a variety of digital devices [29].

2) OLED display (The organic light-emitting diode)

An OLED display in contrast to an LCD display, may function without a backlight because it produces its own lighting. That is why the screen can show such deep blacks, have such a broad viewing angle, and have such a high contrast ratio. Reduced energy use is a direct result of the lack of a backlight. The display consumes 20mA, albeit this value changes based on the

brightness setting. Theoretically flexible, they generate a brighter, sharper image, and are as light as a sheet of paper [33].

(a) LCD Display Unit (b) OLED Display Unit

Figure 9. (a, b) LCD & OLED Display Unit.

Difference between LCD and OLED Unit

OLED displays, in contrast to LCD displays, do not require a backlight, which ultimately results in an improved viewing contrast in settings with low levels of ambient light, this is a significant advantage of OLED displays over LCD displays. These OLED displays are particularly power efficient in comparison to other types of displays. the standard LCDs have to interface with the microcontroller via 12 pin connections, whereas the OLED only uses four pins [33].

5.5 RTC (Real Time Clock)

The device's timing property displays the current date and time like a traditional watch. To ensure time zone accuracy, the time is obtained from the internet. The RTC program is uploaded to the microcontrollers to synchronize the time and date of the time zone specified by the carer or healthcare professional in the IoT platform to be shown by the aid to the user working as usual for reminding the patient with medication scheduling[29].

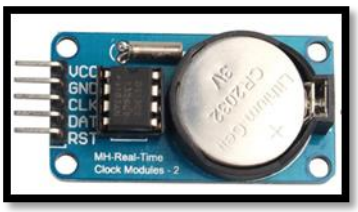


Fig 10. Real Time Clock (RTC).

A timer is created in the software by utilizing the timer widget in the IoT platform, which allows the carer to schedule the time of medicine for every day in hours and minutes formats, as shown in Figure (11). Medication times are also displayed on the LCD as a reminder at times specified by the carer. Figure (12) depicts the medic's reminder message. [29].

Fig 11. Date and Time Reading.

Fig 12. Reminding Message of Medication.

CONCLUSION

The Internet of Things market is showing a rapid and sustainable growth trend, which will promote the development of a variety of microcontrollers and sensors. Since healthcare services are an important part of our society, the services provided by healthcare devices reduce the burden on humans and facilitate measurement. In addition, the transparency of these systems helps patients to trust them. In order to understand and improve the performance of the systems used in the field of health care, we need to study and know the different types of microcontrollers and sensors used in the system and know the characteristics of each of them and the appropriate selection of this system to make things easier for researchers in selecting appropriate types in system design. Knowing the appropriate types of devices and sensors is critical in the system design process. It is important to know the characteristics of each so that the researcher can decide whether the components are suitable for the design. Through our review of the research of a group of researchers, it was found that using the ESP32 unit is better than others for several reasons, including that ESP32 contains the Internet and Bluetooth feature at the same time, in addition to that it has a faster processor compared to Arduino and ESP8266. and ESP32 has more GPIO to work with more project's usability and complexity. As for the Raspberry, it is adapted to robots and businesses that need large data. Therefore, we recommend ESP32 for healthcare applications.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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