IoT based Automatic Handling Operation Theatre using ARM7 Processor

Amrutha.B.R[1], Anusha. S[2], Harshitha. D.S[3], ArunKumar. S[4], Nadimpalli Rajkumar[5]

[1-5]Student, Dept. of Electronics and communication Engineering, Sai Vidya Institute of Technology, Karnataka, India

---

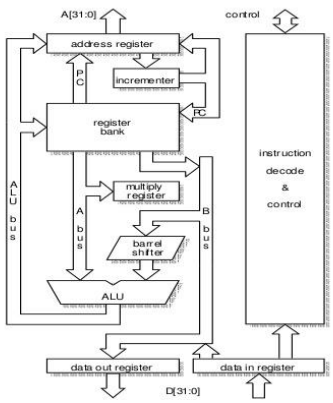
Abstract— *Advancement in Internet of things (Iot) in medical field have resulted in growing importance of surgical systems in the field of automatic handling operation theatre. A smart healthcare is very important for a smart city development. Everything in atomized way are more advantage than the regular method. The various internet of things (Iot) enable devices and its practices in the area of healthcare for children, monitoring of critical patients, operation theatre and medical dispenser. ARM microcontroller use network interface to internet with other devices locally and to push the data to the IoT application for any analysis because ARM microcontroller are less power consumption processors or controller.*

Keywords — (UOI)Universal object interaction, Programmable object interface (POI), Non-sterile, hered theater.

I. INTRODUCTION

Internet if things (IoT) is a network of physical objects or people called "things" that are embedded with software electronic network, and sensors that allows these objects to collect and exchange data. Iot makes virtually everything "smart". By improving aspects of our life with the power of data collection, algorithm and network. The thing in IoT can be a person with a diabetes monitor implant. IoT operating room are more stress less. More advanced and integrated approaches within the scope of the digital transformation of healthcare are starting to be used with regards to health data aspects and IoT plays an increasing role, as it does in specific applications such as smart pills, smart home core, personal health case, robotics and real-time health system.

The ARM Architecture



ARM micro controller plays a major role for IoT automatic handling machine in operation theatre because ARM's 32-bit design benefits from retaining full compatibility with more advanced coding language like c, where an 8-bit device would struggle. The Cortex-M range make use of ARM's thumb2 instruction set, rather than the full 32-bit ARM set that we in our Cortex-A powered smart phones, which provides a subset of the most commonly used 32-bit ARM instructions which have been compressed down to 56 instructions for improved efficiency. 32-bit processors benefit from quickly being able to perform complex tasks, as they send more data around per clock cycle. This particularly useful for low power devices which spend a lot of time idle, as 32-bit ARM processor can perform the task fast and then go back to rest. This means it that doesn't need to be powered on for as long. ARM as focused heavily on improving the energy efficiency of its processors for low power devices. This is hugely important for always on the technologies and which demand long battery lives. More sophisticated smart IoT devices won't be built from single input and processors, but will most likely require a number of low power microprocessor with which to perform various tasks for a wide range of sensors and input. ARM calls this technique "sensor function".

The automatic handling operation theatre using ARM7 processor is based on Iot. Iot can be described as connecting everyday objects like smart phones, internet TVs, sensors and actuators to the internet where devices are intelligently linked together enabling new forms of communication between things and people. Here we propose an internet based automatic handling operation theatre that allows a single operator to control things with the help of ARM7 processor and IoT. Here IoT is for web serve interface and ARM7 processor to process and run circuit loads.

Operator is allowed send commands for machine over internet using IoT from anywhere. The ARM7 takes these commands by internet and processes the received data to follow the user commands. After receiving commands it displays it on LCD display. Also this switches the load on/off based on the received commands to achieve the proper output which are expected.

II. ARM7

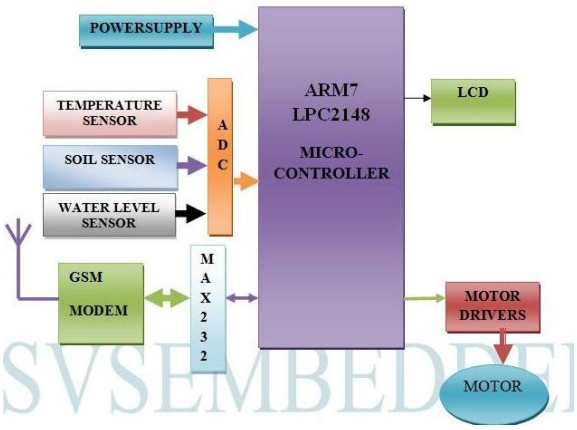


Fig. 1. ARM7 connected to LCD

In this model consists of a power supply unit which gives the required voltage to ARM7 processor. Use sends the command for switching to the ARM7processor through internet using IoT. ARM7 processor processes received data to extract user commands. After getting commands it displays on LCD. Then, it switches the load on/off based on the information received.

Block diagram is an example that we can implement the project and the various devices involved in it. The power supply block gives the required voltage of 5v to ARM7 processor and the LED glows indicating that the system is ready for use. Then the user is allowed to send the commands for devices over the internet using IoT interface from anywhere. The ARM7 captures these commands and displays. The relay driver is used to drive the relay circuits which switches the different appliances connected to interfaces. The input from the user is feed to ARM7 and processed to operate the task semi autonomously and autonomously. Where the control unit is powered and operated properly.

ARM7 LPC2148 is one of the widely used microcontroller based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded support. LPC2148 is RISC based processor that uses transistors than other typical processors. Hence it leads to low cost and low power consumption. The main reason behind selection of ARM& is its support for uC/OS-II RTOS for real-time execution of tasks. Programming is done using embedded C-language with the help of Keil UV4 software tool

III. MEDICAL CARE SYSTEM BASED ON IOT AND USING ARM7 AS A PROCESSOR

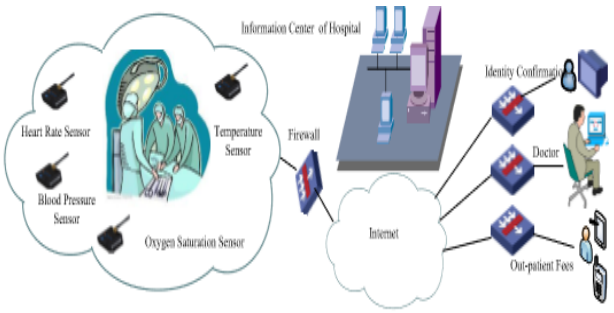


Fig. 2. IoT based medical care system

The use of IOT technology in medical equipment's has become crucial for the modern world. There may be medical accidents due to some unpredictable scenarios due to human factors, therefore with the help of IOT technology the precision of some important medicines can be monitored. Hence lowering medical accidents. Realization of dynamic observation of diseases, and analysation of the diseases which promote digital progress in medical field can be done through IOT technology.Fig.2. Illustration of IOT based medical care system.

IPPG- to detect variations in blood volume in capillaries and micro arteries, a new photo-electronic detection technology called IPPG is used, which involves measuring the reflected light intensity after living tissues is irradiated with photoelectric device. The factor that effects the skin optical properties is the light absorption by hemoglobin, melanin, subcutaneous moisture and other factors. Of all these factors blood id the one which has highest light absorption. The irregular flow of the blood through the blood vessels effect the intensity of the reflected light, when the light enters the hypodermal tissues of the skin. In which the blood flow produces an AC component of light signal and the surrounding tissue that reflects light creates DC component of the light signal. The variation in human skin color is linked to the variation in blood flow through the capillaries and arteries. A great difference in light signal reflected by the muscular network can be detected using imaging device to capture the light The IPPG signal originates when there is pseudo difference caused by the reflection of the skin capillaries to light which influence the signal. An extracted signal with low signal-to-noise ratio is generated by unstable light sources. Certain studies on IPPG focus mainly on image quality, frame rate, motion pseudo difference, region of interest, and clinical trials and applications. To obtain all the physiology parameters with high accuracy, a studies based on video-based non-contact heart-rate estimation is being carried on. New innovations and ideas has been evolved for eliminating the interference component of IPPG signal. In 2011, Sun and others used the single- channel independent component analysis method for the

movement attenuation of IPPG based on black & white camera.

Later in 2014, for the signal extraction of IPPG an adaptive filter & the constrained ICA method is used. Some of the interference is done through the large non-skin areas of the face & interference such as blinking, which has a similar frequencies as that of heart rate cannot be eliminated easily by the IIPG signal extraction technique. There was improvement in the pulse signal extraction to further improve the precision. IN 2015, Lam et al. for the decomposition of independent information, linear blind source signals are used. These signals are extracted pulse signals from multipoint local region of the face to eliminate the movement artifacts. This method was time consuming and it was difficult for the random selection of multipoint local regions of the face due to movement in the face. Further Haan suggested a CHROM method. Here the BVP signals are considered as linear combination of the chrominance signal and he established a standard skin color for the white balance camera. He further improved this model by removing the interference whenever there is a movement. In 2016, an author named Wang introduced an algorithm called plane-orthogonal-to-skin (POS) algorithm. In this algorithm a plane which is orthogonal to the skin tone is temporarily standardized for the extraction of the pulse. RPCA is a signal processing method in signal denoising technology. RPCA can re-create low rank and sparse representation components from the already gathered data, from which the information regarding target can be obtained. RPCA has a good signal separation property.it can distinguish between the video backgrounds and the foreground targets.

Wright applied RPCA in a video detection system by forming a matrix with image frames as column vectors. Skin color changes due to the super imposition on repeated variation in the volume of blood by noise due to light, shaking & temperature. This can be estimated by low rank matrix.

From all the above research an IOT technology based heart rate detection technique that combines the low rank and sparse decomposition to denoise the BVP signals and enhancing it to preserve valuable data.

The RPCA algorithm denoises and re-create the chrominance features after the face effect is detected by the face-tracking technology. With the proposed method of heart rate detection, the need for a hardware that is complicated can be eliminated & the working space of the surgical system can also be compacted & minimized. All these commands are received through internet for ARM7 and it will processes the information and LED will glow where the correct operation had processed.

IV. IOT OPERATING ROOM WITH ARM7

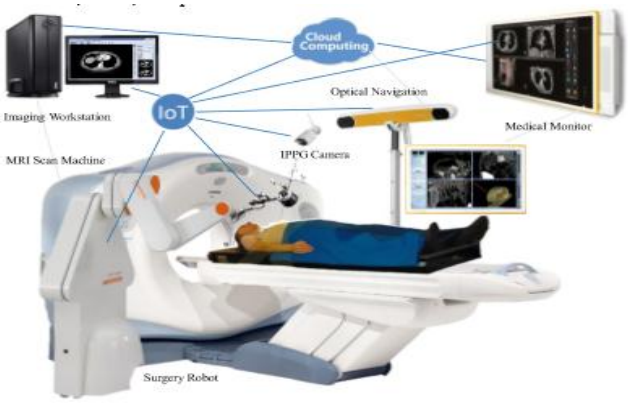


Fig. 3. IoT operating room

The IOT technology and cloud computing improves the medical care and intelligence. Where the ARM processor are used for the processing of commands just because ARM processor are low power consumption and more useful for real-time applications. Software architecture deals with how the data has been processing in the ARM7.

Software architecture

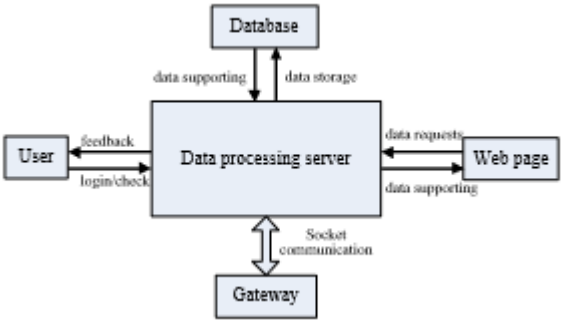


Fig. 4. Interaction between modules and server

The gateway transmits data to the server through socket communication. After receiving the data, the server identifies the data type & the format and stores the information in database. It displays the same data through various charts on web page. After the preliminary processing, the intelligent mode transmits the variation data gathered by the surgical site to the center server. The node also receives command from the control center & carries out the suitable operations according to the commands provided.

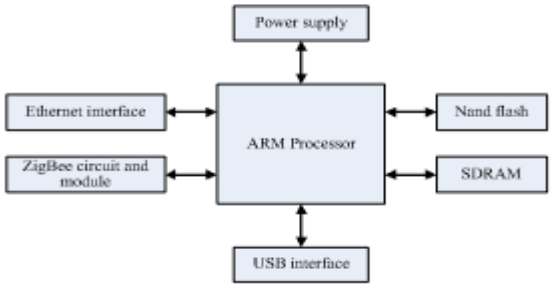


Fig. 5. Software architecture

V. SOLUTION FOR AUTOMATIC OPERATING DEVICES

A. MRI system

Fig. 6. e-Alert MRI system

In world communication awards, Dec 19 (London) e-Alert awarded "most innovative IoT solution". Innovative solution continuously monitors MRI system performance and issues via mobile messaging. Philips e-Alert provides rapid insight into key MRI parameters, helping biomedical and Philips service engineers take fast action to solve problem. The smart sensor-based toll measures environmental factors against thresholds, triggering an alert if a parameter diverges from predefined value. Philips e-Alert offers remote monitoring, alerting independent of region, system age internet access, or phone network coverage. Depending on the MRI system configuration at your hospital facility and your local needs a hardware solution or a software solution may be installed.

B. Ventilation

Fig. 7. IoT in ventilation

The IMT medical Bella vista gateway it's a gateway device that sends patient data from any kind of ventilator to any kind of mobile device they have ARM7 as a controller and GSM as a data pathway for mobile network. Doctor's outside the hospital can still get regular updates on their patient's conditions. No more regular calls to nurse in their own time. Each doctor has individual login so data privacy will be there. This mainly used when a patient is seriously suffering from the respiratory problems.

C. Laparoscopic

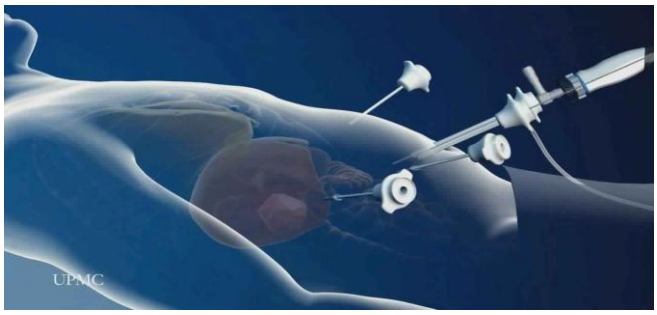


Fig. 8. Laparoscopic

A medical robotics assistant for minimally invasive surgery is due to its modular design, the robotic assistant is defined as a multi-purpose toll that has been successfully used in laparoscopic surgery, cystoscopy diagnostic and transurethral resection.

Laparoscopic surgery is one of the example of minimally invasive surgery, it is a type of surgery that uses smaller cuts than you might expect, and it is an attractive alternative to the open surgery. The process takes its name from laparoscope, a sender tool that has a tiny video camera and light on the end. When surgeon insert this this tool through a small cut in your body, and they can look into monitor to see what happened inside you. Whereas the same operations are performed using specialized instruments designed to fit into your body by making much larger opening without these tools. It have many advantages composed to traditional surgery, they are it has smaller scars, can be discharged quickly, reduces pain while the scar heals fast. In these kind surgeons only uses the visual feedback information provided be the cameras attached to endoscope.

VI. ARCHITECTURE FOR AN OPERATING ROOM BY NFV THROUGH IOT

Network function virtualization (NFV) provides the scale and flexibility necessary for IoT service be enabling the automated control, management and orchestration of network resources.

A. Proposed IoT architecture

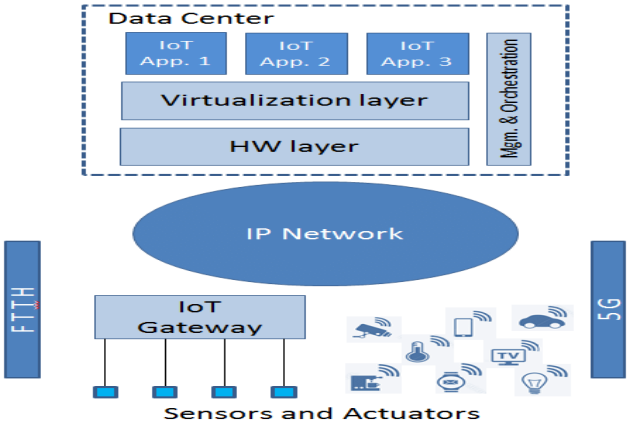


Fig. 9. IoT architecture

The predicted explosion in no. of connected devices by 2020 stated by several studies which promises that the potential for innovative application across different industries. The price to be paid for the application across different industries. The price to be paid for the applications is reflected to manage multiple tens of billions connected devices and corresponding networks called internet of things (Iot). The benefits of network function visualization (NFV) an IoT architecture is architecture leverages. This architecture is innovative, modern operating room innovative center (OPIC).

Figure.9 outlines our architecture in an environment where IoT devices are connected over IoT gateways. The NFV enables IoT gateway to be simple instead of containing application logic-providing translation between the two protocols for simple IoT devices such as sensors and actuators. IoT applications are running in the data center on standard hardware which is shared among different application. The HW layer consists of scalable and electric hardware platform. This is used by virtualization layer to provide virtual machine towards applications. The management of IoT applications, and also the coordination of resources and different applications.

NFV is combined with software defined network (SDN) for multiple synergy affects. It is flexible to dynamic move in a network function from one data to another without any device interpret.

B. OPIC environment

Fig. 9. OPIC environment

The most operating rooms are complex and cost intensive, as they have to undergo the demands for technical infrastructure and related procedures. Currently we are constructing high-tech fully functional operating room with accordance with health department and technology. Figure. 10 planned OPIC operating room. They are used for both education and research activities. There is a demand for scalable and flexible solution in operating room this includes lighting, cooling system medical devices, video conference system and monitoring devices.

C. OPIC IoT architecture

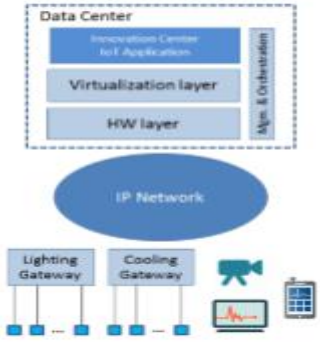


Fig. 10. OPIC IoT architecture

Figure.10 tells us about IoT architecture in OPIC environment. The lighting system and cooling system are made by many number of sensors and actuators connected over a protocol with corresponding gateway. The cooling system is made up of power full ventilation system which provides ideal airflow and temperature in critical situations. Like for fully dressed and active surgeons and for patient, not active and naked. This possible only when multiple sensors and actuators. Without the need of gateway some devices are connected directionally to IoT application. There are more sophisticated that sensors or actuators.

VII. CONCLUSION AND OPERATING ROOM FOR FUTURE

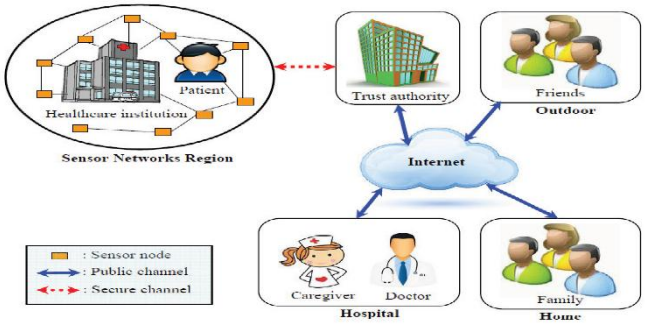


Fig. 11. Future operating room

The term operating room of the future first appeared in PubMed in a 1992 by Jolesz and Shtern. The ORF is an integrated room where modern imaging, visualization, informatics and surgical technology work together for patient care. These information can provide medical services and this leads to construction of smart city. The smart hospital market is driven by demand for remote patient monitoring management, introduction of advanced hospital infrastructure. Patient information security and privacy concerns, lack of IoT technology skills, and lack of clinical-grade mobile applications have restrained market adoption. In this IoT technology for any automated machines we require ARM as a controller, this plays a major role for the better performance as this consumes less power and more effective than any microprocessor or a microcontroller. The main reason of selecting ARM7 or any ARM processors is it is more helpful for real-time application. In this present paper, noncontact heart-rate detection, robotic assistant in minimally invasive surgeries, operating room, medical care system, picture variations in skin images can directly manifest variations in iPPG signals, NFV enabled IoT architecture are achieved. Overall this research says that IoT is the key for smart hospital and urbanization.

References

[1] Hyosig Kang and J. T. Wen, "a robotic assistant in minimally invasive surgeries," IEEE conference on robotics and automation, vol:2, 2001.

[2] Igor Miladiovic and Sigrid Schefer-Wenzl, "NFV enabled IoT architecture for an operating room environment," 2018 IEEE 4th world forum on IoT,2018