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Review: Development of a Multi-Functional Nurse Robot for Enhanced Patient Care and Vital Sign Monitoring in Hospitals

Hesham Mostafa

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Review: Development of a Multi-functional Nurse Robot for Enhanced Patient Care and Vital Sign Monitoring in Hospitals

Hesham Mostafa[1]
[1]*Student at Faculty of computers and Artificial Intelligence, Egypt*

Abstract: The goal of an active hospital is to improve patient care and lessen the strain on physicians and nurses by cutting down on errors. The major goal of this research is to create a Nurse Robot (NR) system that functions as a diagnostic tool and can be programmed with a multi-function manipulator to aid medical professionals and patients in healing more quickly. The primary contribution of this research is the development of a multi-functional robotic system that reads vital signs in humans. We can use numerous sensors for the reading pins since the system is developed using an Arduino Uno board. Based on the input data, the output pins are utilized for the robot's interaction with the patients. The method of engagement will be to use the speaker to output sound. Near-Field Communication (NFC) technology is used to read the patient tag given by the hospital as the patient's identification, and infrared (IR) sensors are used to enable the robot to detect human availability, i.e., IR is used to recognize if the patient stands in front of the robot. The Dinamap 825 was the first commonly used automated electronic blood pressure monitor. The Intel 4004, Intel's first CPU, as well as an air pump, bleed valve, and pressure transducer were the main parts of the Dinamap 825. These devices were created using the oscillometric blood pressure measurement technique. The novel technology was a breakthrough, particularly for sick individuals for whom conventional blood pressure monitoring presented a challenging issue. The Dinamap Monitor kept getting better as technology developed quickly, eventually becoming quicker and more precise.

Keywords: - Nurse robot, Infrared, numerous sensors, Near Field Communication, Vital signs.

1.Introduction

As electrical and computer engineers, we are constantly looking for methods to solve problems and avoid mistakes. As a result, we may support and encourage medical advancement, enhance the standard of care, and provide direct patient care via robotic nursing (NR) [1][2]. To live a simple and pleasant life, new NR may also assist lower error rates and alter medical care norms. The goal of this research is to create human-robot interaction utilizing different platforms, such as nurses, to serve patients quickly and easily while also lessening the workload placed on nurses [3]. Such NR would provide human nurses more peace of mind by sparing them the time

and energy required for tedious or regular nursing activities, allowing them to focus on more challenging jobs without feeling under strain. However, such NR systems are never intended to offer the patient any kind of medical care [4][5][6].

According to theory, the workspace of such an NR system would typically be contained within a single room. The goal of an active hospital is to decrease patient wait times, the workload of the physicians and nurses, and the frequency of errors. It seems feasible that a robotic nurse might provide patient care. The capacity to assist is a robot nurse's greatest strength [7][8][9]. They can assist with repetitious duties including recovering medical supplies, delivering food and medications, and supporting ongoing development and exchange. Robots that prepare personnel can also be helpful. The primary goal of this research project is to create a nurse robot (NR) system that serves as a diagnostic tool that is programmable, multi-functional, and created to assist doctors and nurses in completing their duties to the best of their abilities and aid patients in recuperating more quickly. Regular patient files are collected by hospital nurses, who also check on each patient, write a status report, and then bring it to the doctor's office. They must perform this several times each day and then return it. The primary goal of this research is to address this issue by developing and testing a nurse robot (NR) prototype that can accurately measure multiple vital signs for any patient, including heart rate, blood pressure, oxygen saturation, and body temperature, and transmit that information to the treating physician [10][11][12]. As technology develops, becomes more affordable to use, and is more widely available, human healthcare personnel are benefiting more and more from its uses. Medical experts are testing new ways for robots to advance quickly and play a bigger role in healthcare settings. Toyohashi University of Technology, which created Terapio (Figure 1), a robotic medical cart that can conduct hospital rounds, dispense prescriptions and other goods, and retrieve data, is where nurse robots first gained popularity. A person, such as a doctor or nurse, can utilize the robot to accompany them and use it to collect and access patient data. Although Terapio isn't a humanoid, it does have expressive eyes that alter form and give the impression that it is. Given that it interacts with patients only seldom, collaborates with staff members, and has a neutral look, this kind of robot will probably be among the first to be used in hospitals. Robots like Terapio are helpful in nursing homes and other circumstances requiring care, which is particularly beneficial to the healthcare sector. "Robot nurses" prototypes might have both beneficial and harmful effects. The absence of "human touch" in robotic nursing aids is a negative [13][14]. Robotic nursing assistance is more likely to free up nurses to perform more fulfilling tasks while reducing stress at work. Robotic nurses will be able to triage patients in clinics, ERs, and through telemedicine services to expedite treatment and offer standardized methods for symptom management with far less resources [15][16]. With the push of a button, robot nurses will assist us in prioritizing our care and arranging duties throughout our nursing shift. Because most of the charting will be automatically assigned to artificial intelligence, nurses will have less work to do and less time to do it[17][18].

2.Methodology

The NR's operational procedure may be distilled into the following:

1. The patient is initially given an NFC (Near-Field Communication) tag by the hospital administration, which stores the patient ID that is supplied by the hospital administration. The patient is then instructed to proceed to the patient waiting area, where the NR system is placed [19][20].

2. Since NR and the administration system use the same database, NR will then be informed by the updated tag ID.

3. Subsequently, NR receives the new ID and notifies him to approach it through the speaker. Using a passive infrared sensor (PIR) that creates a beam field in front of it, NR will be able to identify any human-sized objects that block part of this field and the human that is standing in front of them.

4. The patient is then instructed to pass the NFC tag via a specified point on the NR system so that the system may read the tag ID and compare it to the new one that is received from the administration system.

5. Should the IDs match, the NR instructs the patient to place the vital sign extraction apparatus on his hand with the intention of reading them.

6. The measured data will then be collected and stored in the administration database together with the patient ID file.

When a new ID is received using the Bluetooth serial data monitor, the Bluetooth NR initiates the serial receiving of that ID. The motoring is done to listen on the port that relates to the administration Bluetooth device to send and receive data using TX, RX serial communication protocol.

After the patient receives the ID tag from the administration, the system automatically communicates the new ID to NR via the Bluetooth serial. NFC Tag reading utilizing the NFC Reader shields. After the third function "patient standing detection" is activated, the NFC will scan the patient-provided tag and compare it to the new ID obtained.

Measure vital signs using sensors that are compatible with Arduino: NR will ask the patient to use the equipment for measuring vital signs to take the readings and extract the data [21][22][23]. NR will repeat the NR tasks and use the Bluetooth connection to deliver the measured data and patient ID to the administration. Using a PIR sensor to detect human movement to find the patient who is in front of NR. As soon as the patient approaches the NR, the NFC shield must read the tag and match it to the ID that was provided by the administration [224][25][26].

3.Specifications for System Components

1. Arduino UNO: An ATmega328-based microcontroller board. It has a ceramic resonator with an A16 MHz frequency, 14 digital I/O pins, a power jack, 6 analogue I/ps, a USB port, an RST button, and an ICSP header.

2. Raspberry Pi: a Linux-based microcomputer with GPIO (general purpose input/output) ports that let you explore the Internet of Things (IoT) and control electrical components for physical computing.

3. NFC Shield: This Arduino-compatible device reads and writes data into passive NFC tags. 13–26mA, 3.3VDC current. 10–13 mA at 3.3 VDC is the idle current.

4. The MLX90614 is an infrared temperature sensor used to monitor temperature without touching it. At room temperature, it has an accuracy of around 0.5 oC and can measure temperatures between -70 oC and 380 oC.

5. The NB023 analogue sensor uses "photoplethysmography" (PPG), or the technique of utilizing light to detect blood flow, to provide heart-rate information. It has a tiny LED on it that illuminates the skin with green light [27][28]. The blood flowing through the wrist interacts differently with the various light wavelengths coming from these optical emitters.

6. The HL868ba is a common medical device that automatically checks blood pressure by putting the arm inside the machine.

7. PIR Sensor: A control circuit board is attached to an infrared sensor. You may change the sensitivity and holding period. Working Voltage Range: 4.5VDC to 20VDC, 60A current drain.

8. The temperature sensor LM235 is simple to calibrate. It functions as a two-terminal Zener diode, and at a breakdown voltage of 10mV per °K, the breakdown voltage is inversely proportional to the absolute temperature. The circuit runs with currents between 450 A and 5 mA and has a dynamic impedance of less than 1.

4.Conclusion

Since NR and the administration system share a database, NR will then be informed by the new tag ID. As was discussed previously, utilizing NR is regarded as a crucial multi-functional vital-signs assessment that will assist hospital nurses in carrying out routine check-ups on new patients. To facilitate direct communication between the patient and NR, the chosen system will be deployed in the hospital patient waiting area. The fundamental justification for this is because NR is seen as a very secure method of measuring the patient's vital signs using electronic sensors that are directly connected to the patient's body. As a result, NR will enable the hospital and the patients to receive better services. We created a survey with the goal of gathering information from

individuals regarding nursing robots to give this project a solid foundation. The poll is built around a variety of questions that enable us to determine whether consumers can benefit from NR, whether they have tried out this type of nursing robot in the past, and whether they feel at ease utilizing its features. Negative findings were obtained, and they relate to a variety of issues, including Users are hesitant to explore new automated service models since they have never attempted this type of service. Since most of the survey participants had never worked with a system like NR before, this survey offered us motivation in every case to finish this project. This leads us to the conclusion that NR will offer a nique method to most people who have never experienced this type of medical treatment utilizing robots and assist them in choosing an appropriate nursing service to guarantee their health is in good hands. The implementation of NR services, probable employment losses, and hefty initial investment costs are the project's drawbacks. Many individuals find working with robots uncomfortable since a robot can never be compared to a human person, and vice versa. The key quality of NR is its consistency and dependability in carrying out its responsibilities. Other advantages include cost efficiency, quality control and increased production, ability to operate in dangerous conditions, data collecting and patient monitoring, and employment in hazardous locations. So, by transmitting the patient's report to the appropriate specialists in a direct and timely manner, emergency cases like heart failure, high blood pressure, and low oxygen levels might be averted.

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