

# Nurse-Bot: A Robot System Applied to Medical Assistance

Jesús Alvarez, Guillermo Campos, Valeria Enríquez, Alexis Miranda, Francisco Rodriguez, Hiram Ponce

*Universidad Panamericana, Facultad de Ingeniería,*

Augusto Rodin 498, México, Ciudad de México, 03920, México

{0143029, 0157975, 0183164, 0178079, 0169490, hponce}@up.edu.mx

**Abstract**—Caring for the elderly and sick people is one of the biggest concerns of families. Those who experience the responsibility and the enormous work involved in this care recognizes that all kind of help it's welcomed. The objective of this paper is to present Nurse-bot as a mechatronics system for taking care of the elderly and sick people. In particular, we refer this device not only as a tool, but with the time and development a true support to the people. It is like-a nurse made robot that monitors vital signs and keeps the information, so that the attending physician has up-to-date parameters before the consultation that allows a better follow-up of the results of the prescribed treatment made by a specialist. A proof-of-concept and the first prototype is presented in this work. Experimental results shows insights that this robot can help people.

**Index Terms**—mechatronics, assistant robot, biomedical

## I. INTRODUCTION

The health comes in two important aspects, physic and mental, occasionally the mental aspect doesn't have a lot of relevance in the medical assistance making that some possible complications may appear. That's when an important question appears: How can a Mechatronic system improve the quality of life for the persons that need a constant health monitoring?.

One of the biggest problems in Mexico City is the lack of money spent in health care, [6] that's why a lot of people don't get a very good treatment or any treatment at all in some cases, this causes that only a few persons in Mexico work in the health area as assistants or nurses, in Mexico theres only 2 persons for every 1000 that work in this area [7] so theres not enough persons to help and assist all the persons with disability or all the elder people that is in need.

According to OECD data in Mexico, the amount of money spent in health care is the minimum compared with other countries OECD (2017) [6], the price of a nurse in Mexico, the PROFECO data shows that the current price for nurse services is \$1,600 dollars per year. [5]

That's the reason to focus in the elder people that requires assistance and a constant health monitoring to improve and make the health care cheaper and easier so everyone can have access to a better health care.

Thus, this paper aims to present Nurse-bot as a mechatronics system for taking care of the elderly and sick people. In particular, we refer this device not only as a tool, but with the time and development a true support to the people. It is like-a nurse made robot that monitors vital signs and keeps

the information, so that the attending physician has up-to-date parameters before the consultation that allows a better follow-up of the results of the prescribed treatment made by a specialist. A proof-of-concept and the first prototype is presented in this work. Experimental results shows insights that this robot can help people.

The rest of the paper is organized as follows. Section 2 presents the related work. Section 3 describes the proposal. Section 4 shows experimental results and discussion, and Section 5 concludes the paper.

## II. RELATED WORK

Intelligent robots are one of the last in the path of innovation and technology, are controlled by a computer that executes the commands of a program and sends them to the manipulator to make the necessary movements, they also send information to the control computer over the status of the process This allows intelligent decision making and control of the process in real time.

### A. Sofia

Intelligent robots (like SOFIA) [8] are the last of this path full of innovation, those robots are controlled by a computer that executes the commands of a program and sends them to the manipulator to make the necessary movements, they also send information to the control computer over the status of the process, this allows intelligent decision making and control of the process in real time.

In some cities like Japan and China these type of robots are being used in hospitals [2], to give patients access and, if necessary, to help them with wheelchairs, they can also guide them through the hospital to the place where they receive the assistance of the doctor. The Aizu Wakamatsu hospital [2], already has more than 100 of this type of robots and even some or most of these robot nurses have screens on their breasts to give attention to children in the hospital, bring joy to people and at the same time help in the treatment of the patients.

### B. Ri-Man

In 2006, the Scientific Research Center for Emerging Issues RIKEN developed a robot-nurse called Ri-Man [3] and whose arms, made of silicone, allow older people to be transported. The country also established a program to build robots for health care and systems that monitor health in the home. But

the vast majority prefer humans or failing that, animals, for that reason, an adorable robot with the appearance of a seal [4] was implemented in the asylums, in order to give the feeling of company.

### C. Cody

For a few people, being touched can be as comfortable as uncomfortable, and now, how do a person react, when is been touched by a robot? The researchers at the Georgia Institute of Technology, had found that people usually have a positive response when being touched by a robot nurse, this change when the people perceives the intent of the robot in some other way. The robot Cody developed by the Georgia Institute [13], had the purpose to clean the arm of a patient, in the experiment, a few people were told that Cody was there just to clean the arm and a few other were told that it was there to comfort the patient, in the results the people felt more comfortable when Cody just cleaned their arm instead of giving them comfort even when Cody was doing the same movement.

### D. Pepper

Pepper is able to communicate and interpret human emotions, went on sale for domestic use, presented to the world at the Tokyo World 2016 [2]. You can work as a medical assistant collecting and explaining diagnoses and results of medical tests to patients. The robot has a height of 120 centimeters and is equipped with sensors and cameras that can read emotions, distinguish genders, estimate the age of their interlocutors and exercise memory through exercises and games.

The advantages of the previous projects are the positive response of the patients with the interaction in their life, the actions and movements of the robot are precise for the correct care of the patient. Their work as a medical assistant, collecting and explaining diagnoses and results of medical tests to patients and give it to the responsible doctor, and based in that, they can give medication assistance. And the plus of one project (Pepper) is interpret human emotions, for the communication with the doctors and patients.

the disadvantages are the large and big dimensions of the robots, although they need a strong frame for resist the weight of the patient, the goal is always be less invasive in the patient life.

The advantages of "Nurse-Bot" project are that they don't only pursue the assistance to the patient in a physic way but to assist the patient either in a physic and a mental way to maintain the patient optimistic and in a good humor to surpass his illness or his time. In this way they also will help to maintain a relationship between the family and the patient so they can get all the vital information of the patient status.

## III. DESCRIPTION OF THE PROPOSAL

The principal scenario is a common bedroom that will measure between 10-13 ft width and 6-10 ft long. Thats why it has a measure restriction, and this device has to be smaller

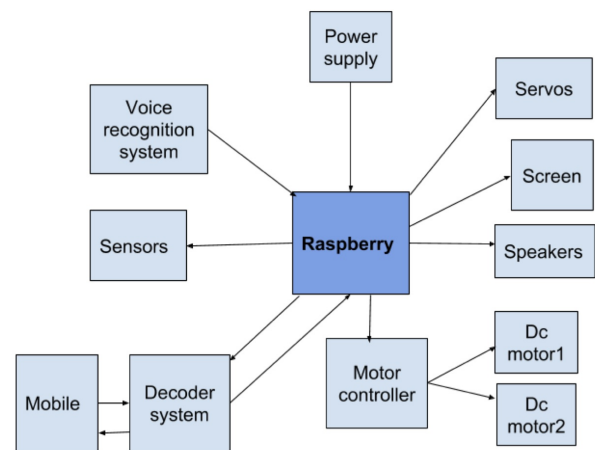


Fig. 1. Block diagram of the robot system.

than 1.64 ft width and 1.64 ft long, so it could fit anywhere in the room and accomplish all the goals for what it was made.

For safety, the system needs to have sensors of proximity so it can be able of avoiding a mascot or person, and doesn't cause any harm to them. The way we would test our system, is programming a trajectory of movement in the room and house, and if it's able to complete the trajectory avoiding the persons or obstacles, then it will be satisfactory.

We selected the echo from the same evaluation matrix of the tentative selected alternative solution for the generation of scenarios, because it would have a widespread area of recognition, this was because in the criteria of evaluation we set the size, weight and safety, and the medicine dispenser, the circular one with movement, because it's the one that will be more efficient giving the medicines to the patient and the one that will help the most.

For the vital signs measurement we select the fixed station because it will be more comfortable for the user, and would have less fluctuation and be more reliable in the measures.

For the vital signs measurement we select the fixed station because it will be more comfortable for the user, and would have less fluctuation and be more reliable in the measures.

Figure 1 shows the block diagram of the proposed robot.

In Fig. 2, we show the general view of the 3D render of the concept proposal.

### A. Electronic components

The project use the following sensors:

- 1) Pulse Sensor Amped
- 2) Temperature Sensor
- 3) Heart Rate sensor
- 4) Camera (PIXY CMUcam5)
- 5) Encoder (CIMcoder)

The electronics hardware:

- 1) Raspberry PI-3
- 2) Echo-Amazon

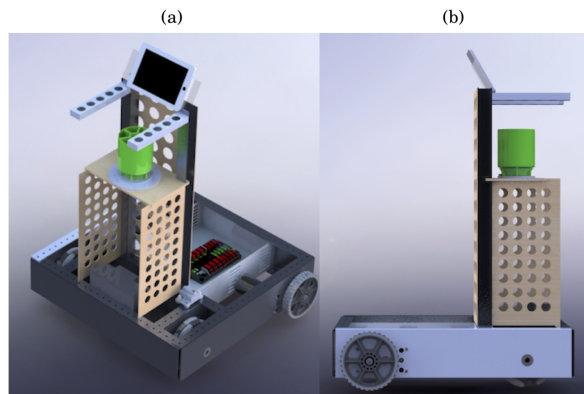


Fig. 2. Views of the robot: (a) isometric view, (b) front view.

- 3) Spark Motor Controller
- 4) Smart Robot Servo
- 5) Voltage Regulator Module
- 6) Power Distribution Panel

#### B. Software

The software that we select are:

- 1) BLINK (Internet of things software)
- 2) Libraries for using the echo with the raspberry
- 3) Python
- 4) Telegram Bots

#### IV. EXPERIMENTATION

For the experimentation with the Nurse-Bot the team designed a experimentation methodology in which explores the capacity of the robot that will be necessary when the device be in the market.

##### A. Checking Vital signs

The Robot has three sensors just for the measurement of vital signs of the patient with these the robot ensures a high rate of precision when checking, making this device reliable. The patient just need to wear a bracelet that has two sensors that send the vital signs to the computers device that process the information and shows it in the panel's device. Table 1 summarizes the results of this experiment.

##### B. Gives medicines

A dispenser that gives the pills when it's needed, it was designed as a mechanical device that works when it's needed following a schedule made by the person in charge. Then, Table 1 summarizes the results of this experiment.

##### C. Mobility within the assigned area

Making a device that it's mostly autonomous it's necessary for a few patients that have special needs, this is why this robot can move just in a secured an assigned area, this can be specified by the person in charge, just adjusting a space in the app. Table 1 summarizes the results of this experiment.

#### V. CONCLUSION

Health Care is one of the most important aspect within the Medical field, a lot of people need caring every day an in some countries there's no enough people in the area to attend all the people in need. There have been new and big advances in AI and Robots that can be applied in many areas, this means that the society is a new era for a better interaction between humans and robots, this may sound like Sci-Fi wheres distopic worlds have robots for everything, just because the actual society isn't that advanced in technology and services doesn't mean that in a very few years the robots will supply a lot of the services and tasks that humans do.

Not everything is as cool as it seems, theres some political, ethical, an social implications that people are concern for the using of a device that it is not human and this is more when it's Medical services. People now that a robot can't replace the work of a human doctor or nurse, because the robot doesn't that we call "human factor" or "human sense" because a robot just make a decision based on their programing and a human have a sense of doing thins that a robot can replicate.

Technology does affect the daily life of every person, by one mean or other, and in the next years to come this affection will be greater.

#### REFERENCES

- [1] EC, R. (2017, April 12). Toyota presenta soporte robico para personas con parlisis. Retrieved October 26, 2017, from <https://elcomercio.pe/tecnologia/robotica/toyota-presenta-soporte-robotico-personas-paralisis-414025>.
- [2] R. B. (2016, December 12). La inslita tecnologa que ayuda a la tercera edad en Japn, el pas con la poblacin ms vieja del mundo - BBC Mundo. Retrieved October 27, 2017, from <http://www.bbc.com/mundo/noticias-38265145>.
- [3] Riken. (2011, August 02). RIBA-II, the next generation care-giving robot. Retrieved October 27, 2017, from <http://www.riken.jp/en/pr/press/2011/20110802>
- [4] Xabes. (2015, February 27). Robear: El robot-oso japones, enfermero del futuro. Retrieved October 28, 2017, from <http://xabes.com/2015/02/27/robear-el-robot-oso-japones-enfermero-del-futuro>
- [5] C. G. (2011, January 27). Cuidados de Enfermos. Retrieved October 28, 2017, from <https://www.profeco.gob.mx/encuesta/brujula/bruj2009/bol144cuidadores.asp>
- [6] OECD (2018), Health spending (indicator). doi: 10.1787/8643de7e-en (Accessed on 19 October 2017)
- [7] OECD (2018), Nurses (indicator). doi: 10.1787/283e64de-en (Accessed on 20 October 2017)
- [8] Hanson Robotics. (2017). Sophia. Retrieved October 22, 2017, from <http://www.hansonrobotics.com/robot/sophia/>
- [9] Arreola-Rosales, J., Inbursa, G., and Murillo, J. C. (2017, January 05). Las 7 tendencias tecnolgicas del 2017. Retrieved November 16, 2017, from <https://www.weforum.org/es/agenda/2017/01/las-7-tendencias-tecnologicas-del-2017>
- [10] Al-Razouki, M., and Kuwait Life Sciences Company. (2016, December 22). Seven global medical technology trends to look out for in 2017. Retrieved November 21, 2017, from <https://www.weforum.org/agenda/2016/12/seven-global-medical-technology-trends-to-look-out-for-in-2017>
- [11] (2016, October 03). Megatendencias 2017: Inteligencia artificial, empresas ms giles y trabajo digital. Retrieved November 15, 2017, from <http://www.estrategiaynegocios.net/lasclavesdeldia/1005331-330/megatendencias-2017-inteligencia-artificial-empresas-ms-giles-y-trabajo-digital>

TABLE I  
RESULTS FROM THE EXPERIMENTS FOR THE PROPOSED ROBOT.

Mobility within the assigned place														
	Ahead		Behind		Right		Left		Without obstacles		With obstacles		In a damp floor	
Test	Correct	Angle error	Correct	Angel error	Correct	Incorrect	Correct	Incorrect	Correct	Incorrect	Correct	Incorrect	Correct	Incorrect
1	*	-1	*	0	*		*		*		*		*	
2	*	-1	*	0		*	*		*			*	*	
3	*	0	*	-1	*		*		*			*	*	
4	*	-2	*	-1	*		*		*		*		*	
5	*	0		0		*	*		*		*		*	
Checking vital signs														
	Temperature Sensor			Humidity Sensor			Hearth Rate Sensor							
Test	Time	Correct	Incorrect	Time	Correct	Incorrect	Time	Correct	Incorrect					
1	0.1	*		0.1	*		0.1	*						
2	0.1	*		0.1	*		0.1	*						
3	0.1	*		0.1	*		0.1	*						
4	0.1	*		0.1	*		0.1	*						
5	0.1	*		0.1	*		0.1	*						
Give medicines														
Test	Time	Number	Correct	Incorrect										
1	0.5 s	2		*										
2	0.4 s	3		*										
3	0.6 s	2		*										
4	0.7 s	1	*											
5	0.7 s	2		*										

- [12] C. Holder, V. Khurana, F. Harrison and L. Jacobs. Robotics and law: Key legal and regulatory implications of the robotics age.1(2016). p.p.388-391 Retrieved November 16, 2017, from <https://www.compseconline.com/publications/prodclaw.htm>

- [13] Int J Soc Robot (2009) 1: 319330 DOI 10.1007/s12369-009-0030-6

- [14] D. Park (2016, April 20) Robotic Nurse Assistant. Retrived January 24, 2018, from <http://pwp.gatech.edu/hrl/robotic-nurse-assistant/>