Volunteer Robot Technology in the Pediatric Cancer Community

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Abstract. Cancer has a significant impact on the mental health of patients, particularly children. Cancer causes significant physical and psychological changes in cancer patients, ranging from sadness and worry to fear of the future and death. When dealing with cancer, these young patients must go through a series of treatment or recovery procedures that take time and cause psychological effects such as boredom, anxiety, and stress. Music therapy, for example, is a non-pharmacological therapy that can help reduce the psychological effects described above. Music therapy can also help cancer patients with psychological symptoms such as lowering, improving mood, reducing distress, and overcoming depression. The importance of this research emerged as a form of care and social support for children with cancer who seek refuge in a halfway house, where the researchers have designed a robot that will later assist volunteers in carrying out mentoring activities for children with cancer. This Volunteer Robot will assist in determining the mental health of children with cancer patients, reminding them of drug consumption schedules, and eventually becoming an Entertaining Robot that will produce sounds and music for children with cancer. This Volunteer Robot falls into the Socially Interactive Robot (SIR) category due to the incorporation of AI and IoT on the robot, which allows it to interact with Sound and Music and be controlled remotely via Android.

Keywords: Non-pharmacological therapy · Volunteer Robot · Socially Interactive Robot (SIR) · IoT

1 Preliminary

Pediatric cancer is a cancer diagnosis that occurs in children under the age of 18, including children still in the womb, with WHO data indicating that childhood cancer cases account for 2–4% of all cancer incidences in humans [1, 2].

According to data from the Union for International Cancer Control (UICC), every year there are around 176,000 children diagnosed with cancer, the majority of whom come from low- and middle-income countries [3]. Cancer occurs in more than 300,000 children every year worldwide and 90,000 of them die. The mortality rate from childhood cancer reaches 50–60 percent because patients generally come late or are in an advanced stage due to cancer symptoms that are difficult to detect [4].

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Leukemia (blood cancer), Retinoblastoma (eyeball/retinal cancer), Osteosarcoma (bone cancer), Neuroblastoma (nerve cancer/Neuroblast), and Lymphoma (lymph node cancer) are the most common types of cancer in children. Cancer has a significant impact on the mental health of patients, particularly in children. The Semarang State University psychology journal, "Quality of Life for Cancer Patients" [5], concluded that cancer causes significant physical and psychological changes in cancer patients, ranging from sadness and worry to fear of the future and death.

Non-pharmacological therapies, such as music therapy and another entertainment, can help reduce the above-mentioned psychological effects [6]. Music therapy can also help cancer patients with psychological symptoms such as reducing fear, improving mood, minimizing distress, and overcoming depression [7].

The urgency of this Volunteer Robot Research emerged as a form of care and social support for children with cancer who were in a shelter, where this robot would help identify pediatric cancer's mental health, remind the schedule of drug consumption, and become an entertainer robot, which will deliver sound and music for children with cancer.

2 Overview

Volunteer Robot Technology is a form of robot technology that interacts through voice and gesture. This technology is one of 3 types of robot categories used in the health sector. Robot Nurse can be broadly split into three categories, namely: **Assistive Robotic (AR), Socially Interactive Robot (SIR), Socially Assistive Robot (SAR)** [8]**.**

Robots that are **assistive (AR)** aid persons who have physical disabilities by interacting with them physically. Wheelchair robots and other mobility assistance, robot companions, manipulation arms, and instructional robots are some examples of AR.

Robot that can connect with humans through speech and gestures is referred to as a "**Socially Interactive Robot**" (SIR). The goal of SIR robot is to create tight relationships between users and robots that are friendly and effective.

A robot that helps the user and helps them make demonstrable progress during healing, rehabilitation, and learning is referred to as a "**Socially Assistive Robot**" (SAR), which combines AR and SIR forms.

The Volunteer Robot was designed with the SIR Social Robot concept, which will interact through voice and gestures. The goal of this Social Robot is to enhance communication between kids, parents, and therapists by acting as a buddy and comforter for anxious kids [9].

This robot serves as an entertainer, a distractor, an educator (providing education before medical action is taken), a motivator (giving positive affirmations and entertainment for children while undergoing the medical process), and a social support system for children with cancer. It can interact based on the child's response and can be remotely controlled to communicate with paediatricians [10].

This Volunteer Robot is also designed to serve as a Companion Robot that successfully lessens negative emotional qualities and discomfort when pediatric patients and their parents participate with Companion Robots during medical operations [11] and Social Robots aid young patients in lowering their stress levels. in comparison to Visual

Characters, pediatric patients will be more willing to undertake medical operations when This volunteer robot features Artificial Intelligence that is used to determine the mental health of pediatric patients through the input of the happy, sad, angry, disappointed, fearful, and other push button features. With the help of this intelligence, the system will assess they are physically and emotionally engaged to robots [12].

This volunteer robot features Artificial Intelligence that is used to determine the mental health of pediatric patients through the input of the happy, sad, angry, disappointed, fearful, and other push button features. With the help of this intelligence, the system will assess the mental health of pediatric patients and determine whether they are in good or bad condition. The embedded intelligence will also be used to provide entertainment mode on the robot and deliver alerts when taking medicine (Fig. 1).

The robot's hardware consist of Camera Sensor, Touch Sensor, Ultrasonic Sensor, Arduino, MiniPC, Audio Card, Speaker, DC Motor, Lead Acid Battery, ESP8266 WIFI Module and LCD Screen Display.

The ultrasonic sensor on this volunteer robot functions as a distance sensor, allowing it to maintain its distance from obstacles as it moves. This robot also uses a camera sensor that functions to capture patient images and the location of pediatric patients. The input from the camera sensor and ultrasonic sensor which is processed by Arduino will be the output for the DC motor driver which will drive the DC Motor towards the pediatric patient.

This robot uses 4 push sensors to assess the patient's emotional state, including whether they are happy, furious, fearful, or sad, and 1 press sensor to play music. The term "Audio Card" refers to a device used for sound input, in which audio is embedded in the form of sound with the words "I am Happy" for a happy response, "I am Sad" for a sad response, "I am mad" for an angry response, and "I am terrified" for a fear response, as well as adding with audio carrying encouraging statements, sound containing cautions when taking medication, and audio including music for children's enjoyment. The Smart Speaker will be used to output all audio.

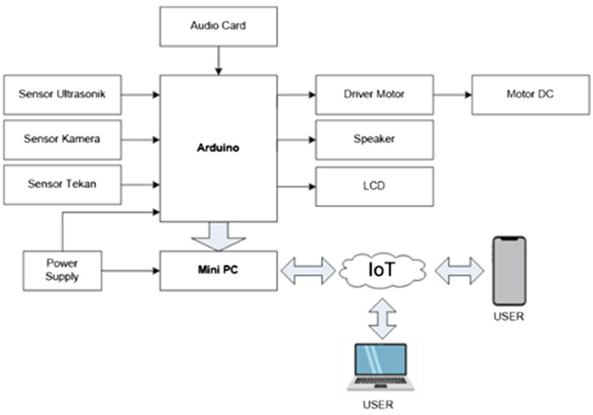

Fig. 1. Hardware Block Diagram of Volunteer Robot

The LCD will display text containing the patient's mental state according to the selected pressure sensor, displaying a medication warning and the music being played.

All inputs into the Arduino are processed by a Mini PC with an intelligence system embedded in it, and the output is provided using the IoT system to ensure that the user may access and monitor it through several devices, such as Android and computers.

3 Methodology

3.1 Systems Design

Before a system, is constructed, a system is designed through a series of activities that can be done individually or in groups (Fig. 2). The system being developed is intended to meet the user's requirements in terms of handling, acquiring, and processing the required information (Fig. 3).

This Volunteer Robot uses the IoT system so that it can be connected to access control and monitoring of the robot by the user (user) via android devices and laptops. Can be seen in the following (Fig. 4).

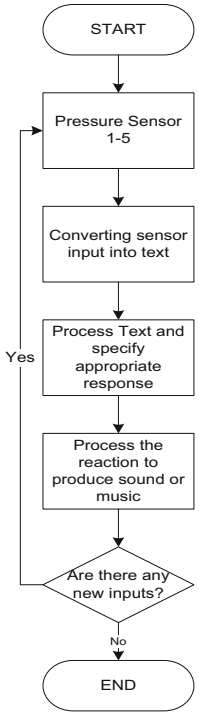

Fig. 2. Hardware Block Diagram of Volunteer Robot

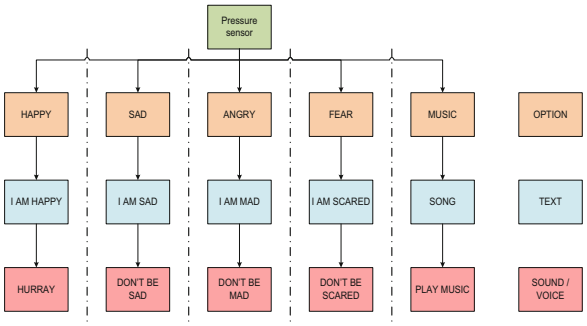

Fig. 3. Optional Conversion Process Diagram to Text and Sound/Voice

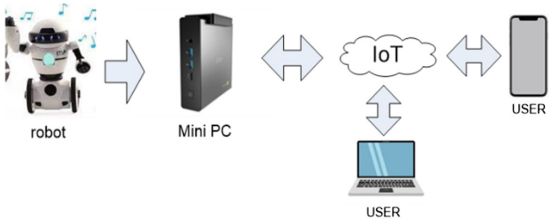

Fig. 4. Robot and user connection via IoT system

3.2 Testing and Analyzing

System testing is a software system execution process that determines whether the software system meets the system specifications and runs in the desired environment. The testing system used in this research proposal is *Black Box Testing*. Black box testing is the process of testing software in terms of functional specifications without testing the design or program code.

The results of the Volunteer Robot Technology research test are shown in the (Table 1).

Three of the 20 tests that were run produced detected expression data that did not correspond to the original expression in question, but all other tests were successful in producing sounds and music. This tool detects facial expressions with an accuracy rate of 85% (Fig. 5).

Table 1. Test Results

No	Detected Expression	Detected Expression	Song	Information
1	Happy	Happy	Sounds	Appropriate
2	Sad	Sad	Sounds	Appropriate
3	Angry	Angry	Sounds	Appropriate
4	Fear	Disgusting	Sounds	Less Precise
5	Angry	Angry	Sounds	Appropriate
6	Happy	Happy	Sounds	Appropriate
7	Angry	Angry	Sounds	Appropriate
8	Disgusting	Disgusting	Sounds	Appropriate
9	Angry	Angry	Sounds	Appropriate
10	Sad	Disgusting	Sounds	Less precise
11	Angry	Angry	Sounds	Appropriate
12	Disgusting	Disgusting	Sounds	Appropriate
13	Happy	Happy	Sounds	Appropriate
14	Disgusting	Disgusting	Sounds	Appropriate
15	Happy	Happy	Sounds	Appropriate
16	Sad	Sad	Sounds	Appropriate
17	Angry	Angry	Sounds	Appropriate
18	Happy	Happy	Sounds	Appropriate
19	Sad	Disgusting	Sounds	Less precise
20	Fear	Fear	Sounds	Appropriate

The test for reminders to take medication was conducted, and it was completely successful. The time for taking medication is set in three reminder times, at 08.00 WIB, 14.00 WIB and 20.00 WIB.

The following is a notification display in the Telegram application when the Volunteer Robot detects facial expressions and a reminder notification when it's time to take medicine (Fig. 6).

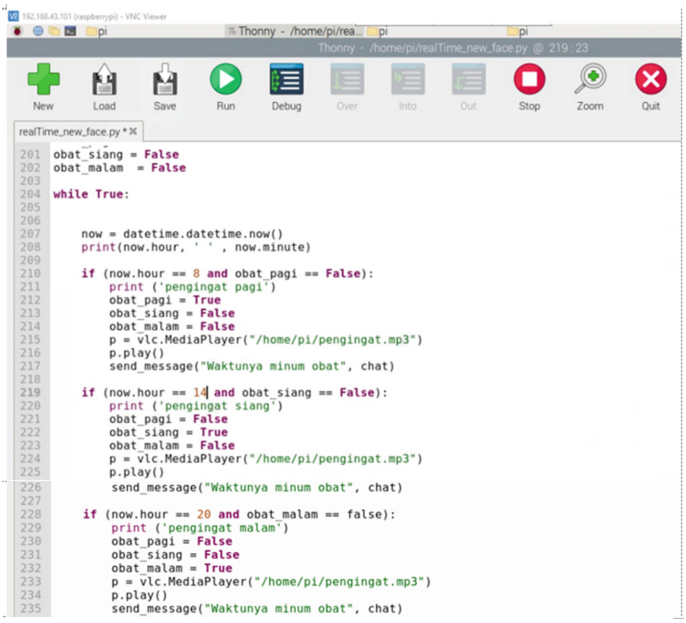

Fig. 5. Coding for Medication Reminders

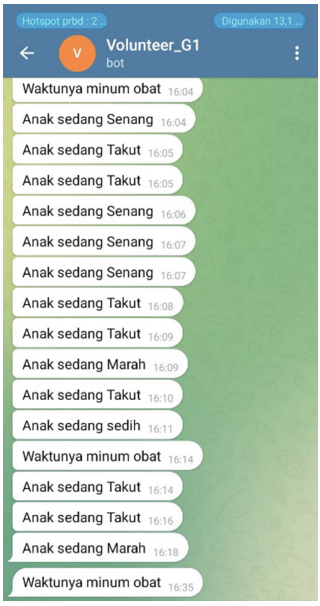

Fig. 6. Telegram application notifications

4 Conclusions

Volunteer robots have assisted volunteers in conducting mentoring activities for children with cancer. This Volunteer Robot will help determine the mental health of children with cancer, remind the schedule of drug consumption, and finally become an Entertainer Robot that will produce sounds and music for children with cancer by combining AI and IoT in the robot, which allows it to interact with Voice and Music and be controlled remotely via Android. There are three inappropriate expression tests out of a total of twenty. This is due to the similarity of expressions of fear with expressions of disgust and expressions of sadness with expressions of disgust. Detected expressions and medication reminders are successfully displayed in real time on the Telegram application.

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