Andalas Medical Robot Assistance (AMIRA) serves Covid-19 isolation patients

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Abstract. The world is currently alert to the spread of a virus known as the coronavirus. Corona Virus or Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a collection of viruses that can infect the human respiratory system until death. The spread of the virus is very fast and easy just by coming in contact with sufferers until it has contaminated almost all countries. For places prone to being exposed to viruses, especially in isolation rooms for Covid sufferers, the medical staff is terrified so that they are always on their toes; moreover, dozens of medical workers have died in handling patients. For this reason, innovation is needed to reduce contact between medical personnel and Covid-19 patients by replacing the duty of humans with robots so that the risk of infected medical workers decreases and avoids the level of work fatigue on the medical worker. The team from Andalas University created and designed a robot that could solve these problems. The robot was designed to perform activities carried out by nurses in serving patient's needs. This robot has the necessary features: food delivery, the patient room's smart position, protecting certain areas with disinfectants, reading the patient's body temperature, and a reminder of the patient's medication schedule anti-collision and providing other smart features which needed by the hospital. This robot is called Andalas Medical Robot Assistant or abbreviated as AMIRA.

1. Introduction

COVID 19 (Corona Virus Disease 2019) is a pandemic disease caused by nonsegmented, single-stranded, positive-sense RNA genomes coronaviruses. COVID 19 emerged in Wuhan, China, at the end of 2019. In the early 2020 disease spread rapidly in China and then across the globe. The liquid spreads coronavirus in the respiratory system, such as mucus. Corona infection is transferred from contaminated air or exposed to a virus that is patched to the object. Coronavirus has many symptoms such as fever, hard to breathe, cough, etc. [1]. An infected person takes 2 – 14 days to realized its symptoms after infection.

In Indonesia, coronaviruses appear in early February 2020. Indonesia’s government takes a serious step by enacting or large-scale social restriction (PSBB) in March 2020. By 31 March 2020, COVID 19 cases reached 1,528 cases with 136 death toll. Indonesia's mortality rate also more prominent than the world mortality rate by 4.68% and 3.79%, respectively per 3 august 2020 [2]. As of 2 September 2020, Indonesia has 180,646 confirmed cases, with 7,616 deaths and 129,971 recovered across 34 provinces [3]. One of the most significant outbreak causes this blown up number is hospital cluster.

Hospital cluster is one of the biggest spread COVID cases. More than 24,000 infected from hospital. From all cases, 63% cases came from a hospital outbreak. One of the causes of big number of
COVID 19 cases in hospital is contact between the patient and the medical team. Daily checking task is the source of communication between patient and medical team such as food delivery, clothes delivery, temperature check, etc. This is a serious risk that can be minimized by using a robot as a delivery assistant.

The hospital cluster is one of the biggest causes of the spread of COVID. More than 24,000 were infected from the hospital outbreak [4]. Of all cases, 63% of cases were from hospital outbreaks. One of the reasons for a large number of COVID 19 cases in hospitals is patient contact with the medical team. Daily check-up tasks are a communication source between the patient and the medical team, such as food delivery, clothing delivery, temperature checks, etc. This is a serious risk that can be minimized by using a robot as a delivery assistant.

2. Materials and methods
AGV (Automated Guided Vehicle) has played a primary role in increasing its efficiency, especially in transportation. AGV plays a role in smart logistics, such as material distribution. The user only needs to assign a delivery task to AGV, AGV delivers goods, product, or material to a designated location. Most AGV system use the priority-based single AGV order task method. AGV received the task with the highest prioritization. When the task is done, the next arranged task can be accepted [5]. By using this method, AGV can do tasks done by medical staff such as food delivery, clothes delivery, room monitoring, etc.

Andalas Medical Robot Assistant (AMIRA) is an AGV that is built to do that stuff. AMIRA will be equipped with an adequate sensor, controller, and actuator in AGV to function correctly.

2.1. Local Positioning System
The navigation of AGV AMIRA is accomplished by using a joystick located in the nurse station. Raspberry Pi 4 is connected to Logitech Extreme 3D Pro by using a WIFI connection. Raspberry Pi 4 sends data to Arduino Uno to control the navigation of AGV.

Infrared Radiation (IR) was installed to detect the surround of AGV. IR is used to track a person or object through the receiver and emitters. When there is an object with a range 1 m from AGV, the IR sensor will send a signal to Arduino that is transferred to Raspberry Pi 4.

Another technology installed to produce higher precision of the local positioning system is using WIFI technology. WIFI module receiver installed in AGV and WIFI module transmitter installed in the wall. By using the distance between the receiver and every transmitter, AGV location can be mapped effectively [6]. Navigation system of AMIRA can be seen in figures 1 and 2.

![Figure 1. IR sensor Range](image)
2.2. Temperature Measurement

One of the symptoms of COVID 19 is fever, so the patient's temperature needs to be regularly checked by the medical team. The medical team was tasked to check the temperature of patients vulnerable to expose COVID 19 viruses. AMIRA is installed temperature sensor to measure the body temperature of the patient. The temperature sensor will help medical team check the temperature of patient remotely. AMIRA will lead to patient location, patient pointed forehead 10 – 20 cm to the sensor. This way, the patient temperature was measured and displayed both in AMIRA LCD and nurse station LCD. The scanning process of temperature measurement by AMIRA can be seen in the figure 3.

![Figure 2 Wi Fi Local Position System](image)

![Figure 3. Temperature Measurement Remotely](image)
2.3. *Anti-collision system*

AMIRA is installed with an anti-collision system by using an IR sensor and vibration sensor. IR sensor is based on reflected infrared from the object in front of the sensor. IR sensor is placed around AMIRA so that whenever an object in a range of 60 cm of AMIRA, AMIRA will immediately stop. The vibration sensor is placed around the bottom part of AMIRA, behind the collision pad. This collision pad is made from soft rubber, so it will absorb the vibration when the collision occurs. Damped by the pad, goods in the upper part of AMIRA will stay at its place when the crash occurs. The vibration sensor will warn the operator via WIFI connection that a collision has occurred. The anti-collision system can be seen in figure 4.

![Diagram of Anti-collision System](image)

**Figure 4.** Anti-collision system

2.4. *Hands-free Disinfectant*

Disinfectant is chemical agents that are designated to inactivate or destroy microorganisms on an inert surface. Coronavirus spread mostly by respiratory droplets and next to contaminating surface by droplets. Disinfectant helped to reduce the deployment of coronaviruses by reducing coronavirus contaminations on the [7]. AMIRA is installed with a hands-free disinfectant located in the upper part,
left side, and right side to prevent coronavirus contaminations. The disinfectant will shoot when the disinfectant channel's sensor detects an object. Apart from being a hands-free disinfectant, Amira is also equipped with room disinfectant spraying. Hans-free disinfectant and room sprayer can be seen in figure 5.

![Figure 5. Hans-free disinfectant and room sprayer](image)

2.5. **Emergency System**

Sometimes, AMIRA is needed urgently, like emergencies situation of the patient. When this happens, AMIRA needs to navigate unhindered. To satisfy these urgencies, AMIRA is installed with an emergency siren. This siren equipped with rotating light and resonate loud sound to alert people. The operator activates this siren. The siren is placed on the top, as seen the figure 6.

![Figure 6. Emergency System](image)
2.6. Auto Pilot
AMIRA can be switched between manual and automatic pilot mode. Manual mode is controlled using a Logitech Extreme 3D joystick from the operator's station. The joystick connects to AMIRA via a WIFI connection. Manual mode works in areas outside the range of the WIFI router. Another feature installed in AMIRA is Auto Pilot mode. This mode works by saving frequent commands to the Raspberry Pi's memory. The operator activates the autopilot mode. In this auto mode, a map of the location in a specific area is stored in the controller. The position of the transmitter assists it at a predetermined location. The transmitter sends a signal to the controller via the receiver. To overcome the collision on the underside, eight proximity sensors are applied. Anti-collision is placed on the front bumper.

2.7. Scheduled Delivery
The medical team has a schedule of visits, such as the patient's maternity needs, daily tasks, etc. The more frequent direct contact between the medical team and the patient will increase the exposure to respiratory droplets from coronavirus patients. AMIRA took over the task by programming the robot according to its commands and duties. AMIRA is equipped with a scheduled dispatch program that allows AMIRA to navigate and move to the operator's designated positions. AMIRA will send beverages to coronavirus patients so that the medical team's direct contact with patients will be reduced. Cameras attached to AMIRA can scan QR Codes. This QR code is placed in the designated scheduled delivery area. AMIRA navigates to the patient room area, and then the robot scans the QR Code that has been prepared attached to the door. In this situation, the robot has already known the patient's identity in the room. The robot alerts the patient via a loudspeaker. Then the patient will pick the item up from the AMIRA shelf. Patients must press one of the buttons on the monitor screen, stating that the goods have been received. By pressing the button, one task is completed and ready to perform the next task. Using QR Code technology, this task can be accomplished. The layout of the delivery map can be seen in figure 7.

![Figure 7. Scheduled Delivery Map](image)

3. Results and discussion
This robot has two control systems, namely manual and automatic. The manual method is an application on the operator's computer to control the robot's motion via a joystick. The application is
built using the ECLIPSE IDE application in the Java programming language. The robot has a mini-computer that can communicate with the operator’s computer. The communication system application is built using Python language.

Meanwhile, the Atmega328 microcontroller controls sensors and motors in the robot using the C/C++ programming language. The automatic system allows the robot to deliver goods on a scheduled basis without operator intervention as the robot controller. A local positioning system assists robot navigation. The system is built using several WIFI stations that are placed at predetermined points. The robot will calculate its position with these points by utilizing a large signal strength or RSSI (Receive Signal Strength Indicator). RSSI values are processed by the SVM (Support Vector Machine) algorithm. When the robot is in front of the isolation room door, the camera on the robot will read the QR code and call the patient according to the data in the database built with PHP and MySQL. AMIRA’s system development process is ongoing and is planned to be completed by the end of the year. A rough prototype of Amira can be seen in figure 8.

![Figure 8. Amira in action](image)

4. Conclusions
AMIRA’s features can at least reduce direct contact between the medical team and COVID patients. AMIRA can play an essential role in reducing the spread of the virus. It is crucial to develop robots towards artificial intelligence to provide services to patients by offering hospital features, such as robots that can communicate with patients, entertain patients, etc. Therefore, the involvement of various fields of science is required to achieve this.

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