

**CAPSTONE PROJECT REPORT**

**Report 1 – Project Introduction**

– Ho Chi Minh, September 2022 –

**Table of Contents**

[I. Record of Changes 3](#_heading=h.gjdgxs)

[II. Project Introduction 4](#_heading=h.30j0zll)

[1. Overview 4](#_heading=h.1fob9te)

[1.1 Project Information 4](#_heading=h.3znysh7)

[1.2 Project Team 4](#_heading=h.2et92p0)

[2. Product Background 4](#_heading=h.tyjcwt)

[3. Existing Systems 4](#_heading=h.3dy6vkm)

[3.1 Amazon’s Warehouse Robot 4](#_heading=h.1t3h5sf)

[3.2 STI AGV Robot 4](#_heading=h.4d34og8)

[4. Business Opportunity 4](#_heading=h.2s8eyo1)

[5. Software Product Vision 5](#_heading=h.17dp8vu)

[6. Project Scope & Limitations 5](#_heading=h.3rdcrjn)

[6.1 Major Features 5](#_heading=h.26in1rg)

[6.2 Limitations & Exclusions 6](#_heading=h.lnxbz9)

# I. Record of Changes

| **Date** | **A\* M, D** | **In charge** | **Change Description** |
| --- | --- | --- | --- |
| 24/09/2022 | A | Nguyễn Lê Thăng Long | Added project introduction |
| 26/10/2022 | M | Nguyễn Huỳnh Nhật Minh | Modify project introduction |
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\*A - Added M - Modified D - Deleted

# II. Project Introduction

## 1. Overview

### 1.1 Project Information

* Project name: An implementation of AMWR system for automation warehouses
* Project code: FA22SE14
* Group name: GFA22SE30
* Software type: Arduino, Mobile App.

### 1.2 Project Team

| **Full Name** | **Role** | **Email** | **Mobile** |
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## 2. Product Background

Self-driving vehicles or automatic vehicles are now necessary tools in the marketing and innovation industry around the world. Robotic technology has been widely applied in many fields in many countries, it has brought great efficiency in industrial production, in national defense, health, society, space exploration. Vietnam is still at the early stage of industrialization and modernization. In order to keep up with other countries in the region and the world, the domestic industry needs to access modern technologies and equipment. So, the challenge of miniaturization to save space and powertrains to be efficient and powerful is a fundamental aspect.

An Automated Guided Vehicle (AGV) is a common type of robot used in warehouses for automated transportation. However, in Vietnam, this technology is still limited, especially in small warehouses that don’t have the budget to implement a complex AGV robot system.

Considering the full potential and advantages of the AGV robot, it is valuable to do this project. We want to build a simple AGV prototype model can provide simplest and cheapest solution when moving product in and out of the warehouse. They can only work or do the task on magnetic tape so installation time and maintenance is needed, the safety for the AGV robot as well as the people and environment surrounding it must be provided.

## 3. Existing Systems

### 3.1 Amazon’s Warehouse Robot

Amazon Robotics uses its software and machinery to automate the flow of inventory in Amazon fulfillment centers. There are three main physical components to the company’s system: mobile shelving units, robots, and employee workstations. The robots deliver mobile shelving units to stations, and employees either put inventory in (stowing) or take it out (picking).

It was a Kiva Robot, which is being used to move the stillage with commodities between the areas of the storehouse. The pioneer in introducing such robots was well – known e-commerce company Amazon. The principle of this device is simple – they ride under the loaded racks, move it up by using a special stand, and move directly to the place where it is needed. The vital information is they are being steered by remote – warehouse management systems that use them exactly when it is necessary to pick the commodity in the picking area. Recently Amazon storehouses works more than 45 000 Kiva Robots and it is 30 000 more than three years ago.

Reference:

<https://aws.amazon.com/vi/solutions/case-studies/amazon-robotics-case-study/>

<https://www.researchgate.net/publication/324196408_INFLUENCE_OF_MODERN_TRANSPORTATION_DEVICES_ON_THE_COMMODITIES_FLOW_IN_HIGH_CEILING_WAREHOUSES>

### 3.2 STI AGV Robot

Automated Guided Vehicle (AGV) was born and will become an inevitable trend in Industrialise 4.0 with smart factory solutions including automatic production lines, modern production management systems, and smart warehouses. AGV, cargo transport, AGV/robocar self-propelled vehicle is one of the products of industrial robot manufacturing application of STI Vietnam’s robot integration system for production lines, factories, production, and assembly machines. AGVs have become an indispensable need of businesses that want to improve productivity and keep up with the general development trend of modern industry.

Reference:

<https://stivietnam.com/chuyen-muc/linh-vuc/robot-tu-hanh-agv/>

<https://itgtechnology.vn/xe-tu-hanh-agv/>

## 4. Business Opportunity

An AMWR System for smaller warehouses is needed for saving on material and investment. A smaller AGV robot is light, easy to use, and cheap for smaller storage. The smaller AGV robot can provide smaller warehouses the same experience but it is cheaper, and even increase the capability of its storage by removing unnecessary space for moving trucks or transferring vehicles. Still, this solution can only be used by smaller warehouses because the path it goes is simple. Once the path is established, it is hard to change.

## 5. Software Product Vision

For operators who want to pickup or drop-off product in loading area of the warehouse. The AMWR System is an real-time and smartphone-enabled application that will accept instructions or group meal orders, process payments, and trigger delivery of the prepared meals to a designated location on the Process Impact campus. The mobile application will show most of the activity happening in the warehouse in real-time, and reduce human labor for lifting, and transporting the goods.

## 6. Project Scope & Limitations

The objective and scope of this project are to create a prototype robot model that can follow a trail of lines on a flat surface horizontally and also lift and move products to assigned locations. This robot mode is using Arduino Mega 2560 microcontroller to control all navigation during its operation. In other words, the microcontroller acts just like the brain of the model. A mobile application will be used to monitor and send instructions to the robot through bluetooth communication.

This project consists of four main stages, which are theoretical design, mechanical fabrication, electronic hardware design, and as well as algorithm design in assembly language. The matter to be considered is how the robot can follow the trail of the line continuously. It is also important to choose the most suitable microcontroller, dc motors, and sensors to achieve the project objectives.

Due to the short working time and limited knowledge, the study has the following limitations:

* Robot can only use small power dc motors.
* Using IR sensors to detect and follow on magnetic line.
* Can only operate in confined space.
* Although simple, it still take time to install.
* Mobile application is simple and only use to monitor and send robot instructions.
* Rely on bluetooth connection so there are some delay when communicating.

The goal of the topic is to focus on the problem of road tracking principles and being able to move left, right at an angle of 90 degrees and catch intersections through lines on the way; lift and move goods to another location. In addition, it is possible to control the robot’s movements according to the user’s wishes.

### 6.1 Major Features

RB-01: Move from location to location in the storage system, shorted pathfinding.

RB-02: Having a lifting function.

RB-03: A camera for picture analysis to avoid obstacles while moving from point to point.

RB-04: Adjust speed automatically when robot carry difference weight.

MO-01: Image processing and showing real-time camera video.

MO-02: Assign task like pickup or drop-off product at designated location.

MO-03: Manually control robot in case the robot got stuck.

MO-04: Scan bluetooth devices, and communicate through bluetooth.

### 6.2 Limitations & Exclusions

LI-1: The robot cannot carry heavy objects, the max object weight it can carry and move efficiently is 10 kilograms.

LI-2: The installation process of the system would take time, as installing multiple devices, such as the supervisor camera, mobile app, and robot path mapping in the warehouse.

LI-3: The robot cannot move if there is no line near them, so it always needs a path to run on and has slow speed and instability on different line thicknesses or angles.

LI-4: The camera has a delay and must be connected to wifi to work properly.

LI-5: Because the project is a prototype so the mobile application has low security, everyone who has the app with proper connections can control the system.

LI-6: It is a prototype project, only valid in environmental research, it is hard to rival as practical marketing products.