International Information Technology University Faculty Of Information Technology

“Algorithms for the control and coordination of warehouse robot”

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Introduction

- Conveyors are out-dated, inflexible and maintenance intensive
- Carousel technology is slow and unreliable.
- Traditional automated storage and retrieval system solutions are massive fixed structures
- Automated Guided Vehicles move things from point A to point B - Period

Robotic automated warehouse system the best solution

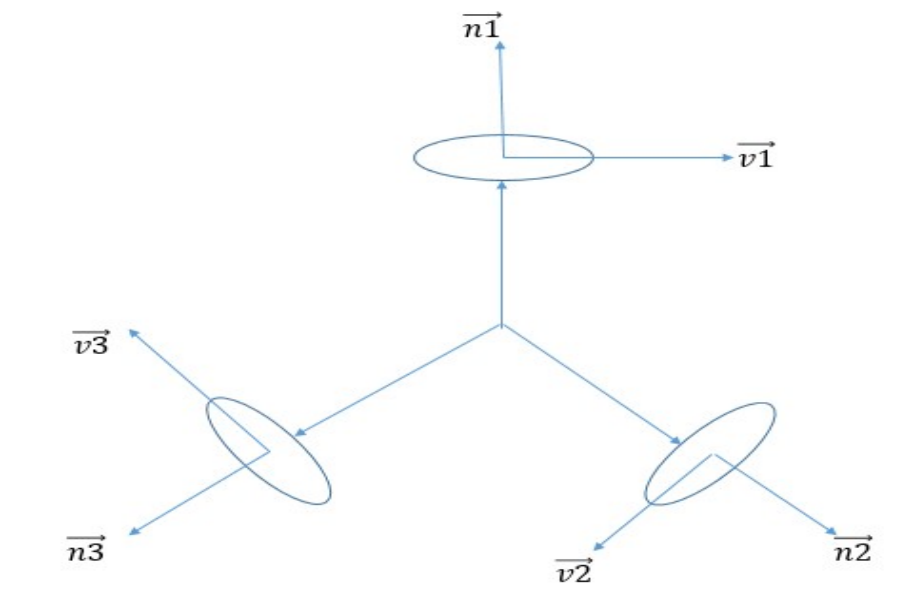
Goal

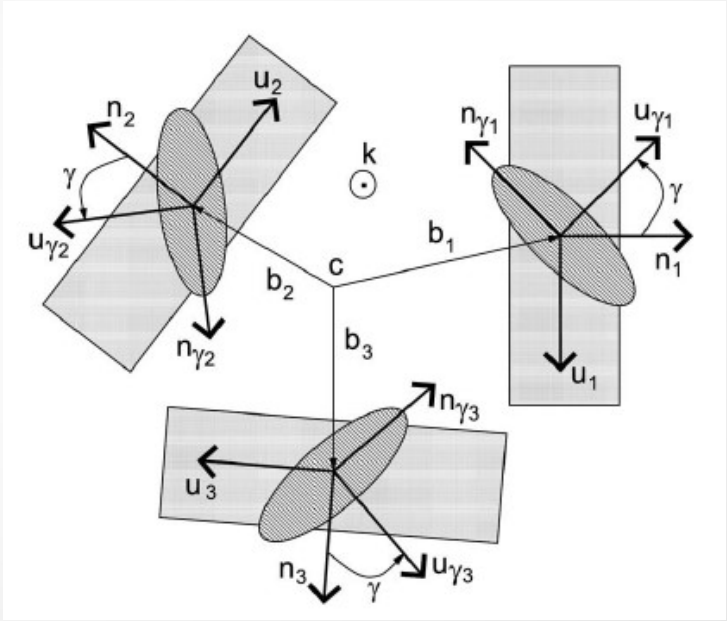
- The aim of the diploma project is assemble the warehouse robot
- Combine the skills of software development and working with electronic devices to assembly robot

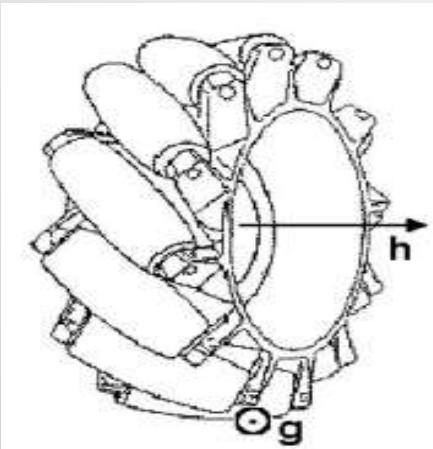
Tasks that are needed to accomplish in order to achieve the goal:

- Need to develop an interface for the execution of orders;
- Interface should provide the service to get information about the new order to the robot;
- The robot has to fulfill the order;
- Receipt of your order will take place by the client;
- The client has to send commands to the robot, the robot can execute the order;
- Robot need to coordinate in warehouse.

Selecting robot platform





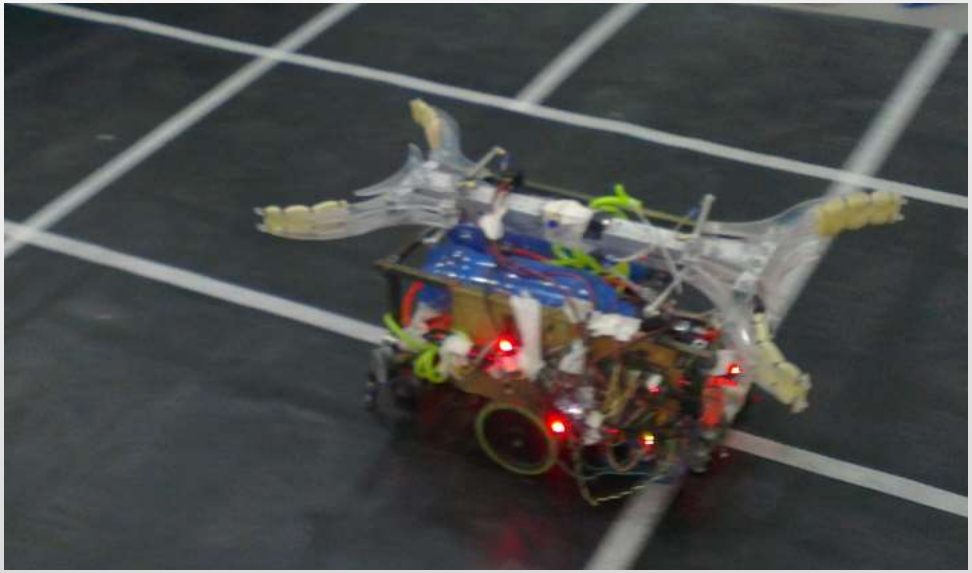


Movement algorithm

- The robot moves focusing on the marked field due to the light sensors;
- Light sensors are installed in six position of robot;
- Infrared distance sensors are mounted in front and back sides of robot;
- Buttons in the front and back sides are installed for emergency stop before obstacles;

Technologies:

- ARM-based processor STM32F100RB;
- Light sensors;
- Motor drivers



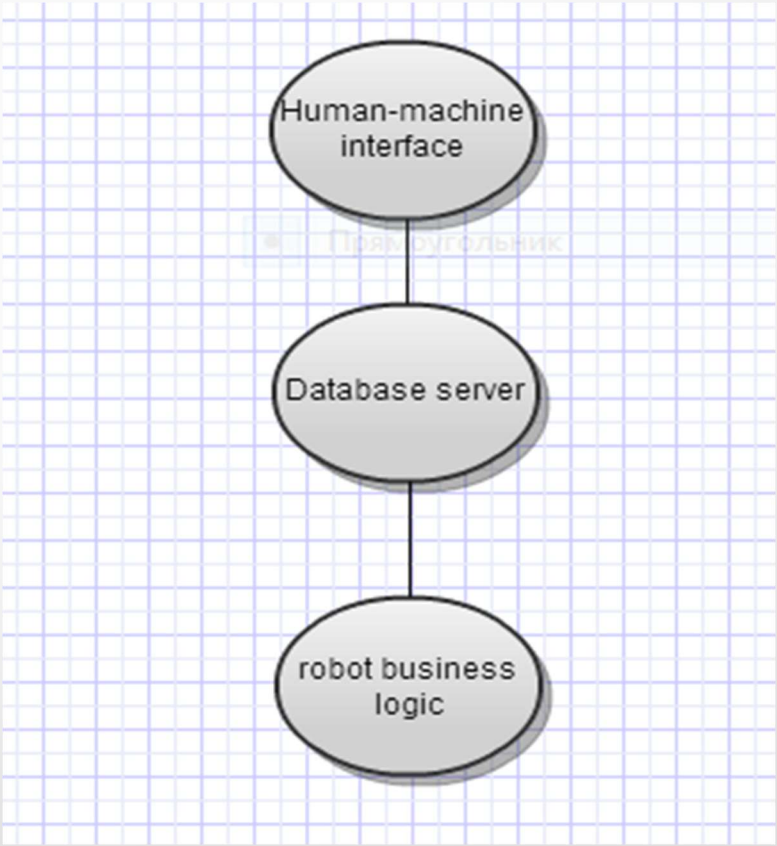
Programming for ARM-based processor my first experience

```
void PwmInit(void) {

        //B1 – A2
        //B0 – A1
        GPIO_InitTypeDef GPIO_InitStructure;
        RCC_APB2PeriphClockCmd(RCC_APB2Periph_GPIOA, ENABLE);
        //DIRECTION
        GPIO_InitStructure.GPIO_Pin = GPIO_Pin_1 | GPIO_Pin_2;
        GPIO_InitStructure.GPIO_Mode = GPIO_Mode_Out_PP;
        GPIO_InitStructure.GPIO_Speed = GPIO_Speed_50MHz;
        GPIO_Init(GPIOA, &GPIO_InitStructure);
        //Power on порт B
        RCC_APB2PeriphClockCmd(RCC_APB2Periph_GPIOB, ENABLE);
        //Power on Timer 3
        RCC_APB1PeriphClockCmd(RCC_APB1Periph_TIM3, ENABLE);
        GPIO_InitTypeDef PORT;
        // Configuring ports
        PORT.GPIO_Pin = (GPIO_Pin_0 | GPIO_Pin_1);
        //Using alternative mode for GPIO
        PORT.GPIO_Mode = GPIO_Mode_AF_PP;
        PORT.GPIO_Speed = GPIO_Speed_50MHz;
        GPIO_Init(GPIOB, &PORT);
        //Give access to time for using ports B0, B1
        TIM3->CCER |= (TIM_CCER_CC2E | TIM_CCER_CC3E | TIM_CCER_CC4E);
        // For all channels set inverse PWM.
        TIM3->CCMR1 |= (TIM_CCMR1_OC2M_0 | TIM_CCMR1_OC2M_1 | TIM_CCMR1_OC2M_2);
        TIM3->CCMR2 |= (TIM_CCMR2_OC3M_0 | TIM_CCMR2_OC3M_1 | TIM_CCMR2_OC3M_2
                        | TIM_CCMR2_OC4M_0 | TIM_CCMR2_OC4M_1 | TIM_CCMR2_OC4M_2);
        //Start the timer!
        TIM3->CR1 |= TIM_CR1_CEN;
}
```

Robotic System

- A worker orders some item;
- System takes order and send task to client in the robot;
- Client communicate with the robot and send commands for robot.



Web Interface Development

Problems

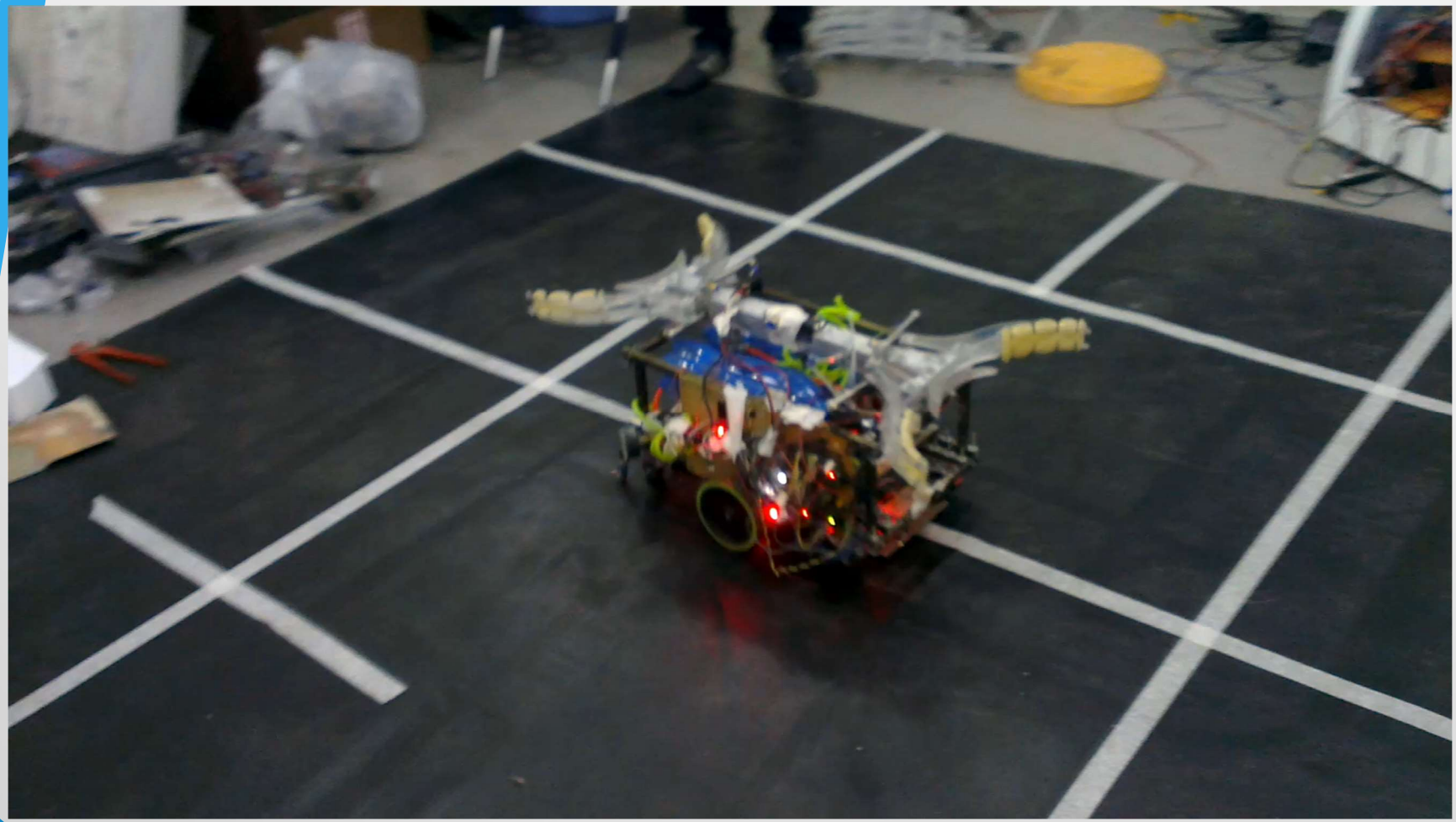
- The main problem was a connection of the robot with the web service. It was difficult to find a suitable alternative connection to the network, receiving and sending commands between controller and web service.
- The method of determining the track of the robot. How to tell to the robot which direction need to go

Solutions

- For the first problem is find a few solutions:
- Connect to the Web service and send commands to the robot via UART, using Raspberry Pi or netbook
- Connect to the Web service from controller using Sim900 scheme

Results

- Was create a commercial product using the acquired skills of software development, and work with both analog and digital devices;
- Was designed web interface to communicate with the robot;
- When choosing a product, an employee commits an order which is sent to the robot by the system to be processed;
- Was constructed robot, which has a two-wheeled platform. The robot moves guided by the light sensor moves relative to the white lines;
- The system has processed the order, order execution is transferred to the robot
- The client communicates with the robot controller through the protocol UART



Economic view

It has been estimated that to build the one robot we need 650,000 tenge. This project will make a small change on the structure of the warehouse system. In stock all kinds of good transportation will be performed by robots. A customer makes an order online, and an employee sends the order, robot brings the order to the worker.

In the robotic system, the order is fulfilled by robots as a whole the target put before us in our project is reached. We have created a new type of a robot, which is unique.

Thank you!