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**Bachelor of Science in Computing**

**School of Public Administration**

**Macao Polytechnic Institute**

**COMP 492 Final Year Project**

**Project Proposal**

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| **Indoor Helper Robot** | |
|  |  |
| Project Number: | 29 |
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|  |  |
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# **1. Main tasks and Objectives**

The main task of this project is to develop and control an indoor navigation robot which can go to a desired place within a room area and do the delivery as a helper. This robot can move following the color line and fetch objects and do delivery. LEGO® MINDSTORMS® EV3 is chosen as the development model.

The following functions should be developed with the robot in this project:

* Move from starting position to different destinations
* Move according color lines
* Turn left or right correctly
* Go back to start area after reaching the destination
* Read NFC tags to recognize places
* Fetch and deliver objects

# **2. Project Description**

In this project the following tasks should be done before the end of next semester.

* Study related works
* Experiment how to place the different sensors
* Experiment how to place NFC tags
* Experiment fetch and deliver different objects
* Design fuzzy logic for movement
* Recognize different color and run action correctly
* Develop a moving road database
* Design the program
* Implement the program
* Writing the report

The following table shows the scope of this project:

**Table 1 Project scope**

|  |  |
| --- | --- |
| Function Provided | My project |
| Color sensing | **√** |
| NFC positioning | **√** |
| Move following the line | **√** |
| Fetch objects | **√** |
| Deliver objects | **√** |
| Move in a room | **√** |
| Move in the same floor | **×** |
| Move in different floor | **×** |

As confined by the Bluetooth signal range, the robot in this project will move in room A322 in MPI, but not move around the whole floor. In the very beginning, this EV3 robot will move on a whiteboard following color lines drawn with highlight pens.

# **3. Summary of Related Work and Key References**

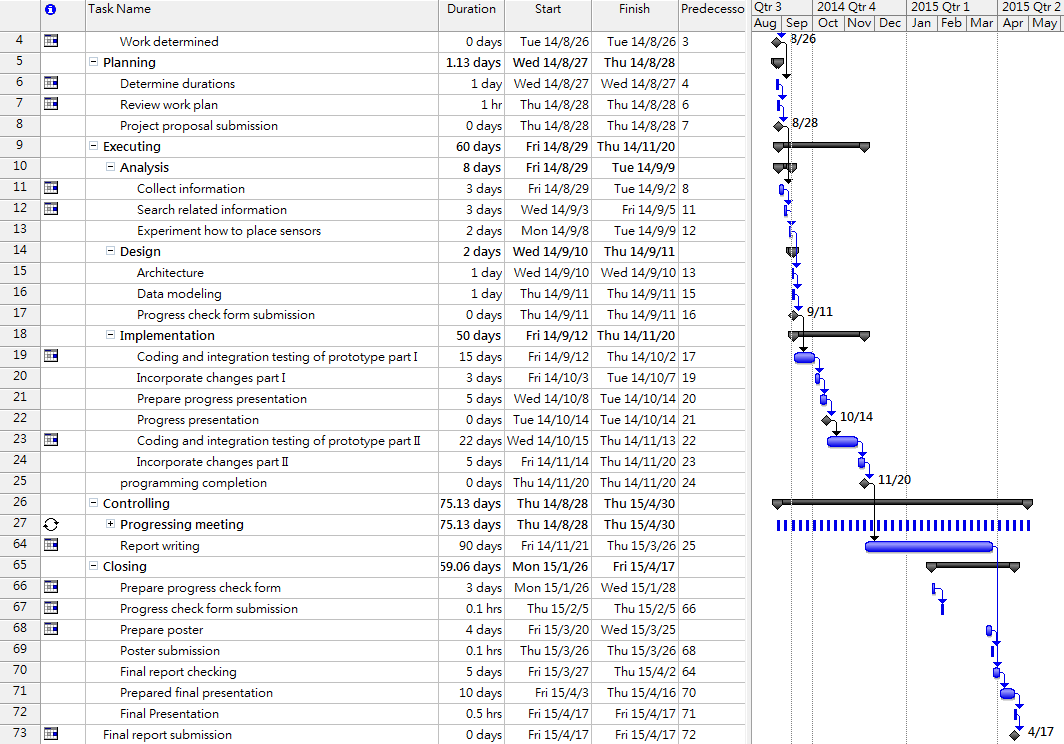
As the development of technology, human interactive robot development has been a big topic in the world. Developing a robot helper instead of human do by themselves has been a trend of people’s interests. Fuzzy logic design, which is introduced in 1960s, will be also used as other similar robot projects. LEGOMINDSTORMS EV3 programmable robot is chosen for doing this project. We can also found the LEGOrobots are chosen in similar projects, such as N.Z. Azlan et al developed two miniature LEGO robots with two light sensors for developing a training system in undergraduate fuzzy logic class [1], H.K. Tripathy et al used Lego RCX microcomputer design a smooth motion robot control [2], etc. One of the main reasons why LEGO is chosen is as H.K. Tripathy mentioned in the article:

*We choose to implement the robot’s brain using the Lego RCX due to the lower cost.*

Also, sensors are found widely implemented with the robots projects like Azlan’s project just mentioned above. Besides Azlan, Gijeong Jang et al also use light sensors to read color landmark to develop a self-recognize indoor robot [3]. In this project, light sensor will be also used to read the landmarks. But unlike the Gijeong Jang’s project, landmark will be used as the moving guide line on the floor for the robots. Light searching experiment in Azlan’s project will not be done in this project but fetch objects will be done as part of this project. In addition, like Azlan’s project, the whole robot will be built with the provided components in the LEGO set except the NFC reader (this will be implement by using a smartphone). However, development language will use MonoBrick which is support with the LEGO MINDSTORMS EV3 robot. None of the projects mentioned above is using MonoBrick language. Therefore, it will be a good try to use another language to do similar experiment as other projects. Moreover, Neural force control for robot indoor positioning can be also found in a concept report about industrial robot position control in Cartesian space written by R Maaß et al [4]. And this approach will be also implement in the project for a better robot position result.

# **4. Project Workplan**

The schedule of all the works are shown in Figure 2



**Figure 1 Work plan**

# **5. Risk Assessment**

During the process, there are four possible risks may occurs, namely battery running out, connection setup disabled, hard disk damage and data lost and motor out of function.

* Battery running-out
  + Firstly, there is a potential risk that battery runs out during the testing period. This will lead the robot unable to move properly. Also, as movement control is designed to use set power volume if the battery cannot provide enough power the moving distance may be affected. Therefore, full-charged backup batteries are prepared.
* Connection setup disabled
  + Secondly, as there are too much radio signals in the campus, Bluetooth connection may be interfered. This makes it impossible to set up the connection between the computer and the robot. If this happens, it is tested to be feasible to move to another place, for example the rooftop, to reset the connection. The connection set up process can be performed at the rooftop of the teaching building, as there is less interferes. Once the connection is set up it will not be disconnected until disconnect operation is triggered, and after connection set up, everything can be move back to the lab and resume its normal operation.
* Hard disk damage and data lost

Thirdly, all the develop programs or documents may lost due to hard disk problem. Therefore, besides saving data in the local computer, at least one copy backup will be placed in a USB and a backup copy will be put in the network. Once development data is lost, backup data will be used to continue the project. Furthermore, all files of the every process will have at least one backup copy so that the project can go back at any time.

* Motor out of function
  + Last but not least, In case of accident, motor of the robot may be out of function. This might stop the robot from moving. If this happen, it is necessary to replace motor with a backup that is in place.

# **6. Reference**

[1] Azlan, N.Z.; Zainudin, F.; Yusuf, H. M.; Toha, S.F.; Yusoff, S. Z S; Osman, N. H., *"Fuzzy Logic Controlled Miniature LEGO Robot for Undergraduate Training System,"* Industrial Electronics and Applications, 2007. ICIEA 2007. 2nd IEEE Conference on, vol., no., pp.2184, 2188, 23-25 May 2007

[2] Tripathy, H. K., Tripathy, B. K., & Das, P. K. (2008). A Prospective Fuzzy Logic approach to Knowledge-based Navigation of Mobile LEGO-Robot. *Journal of Convergence Information Technology*, *3*(1), 64-70.

[3] Gijeong Jang; Sungho Lee; Inso Kweon, *"Color landmark based self-localization for indoor mobile robots,"* Robotics and Automation, 2002. Proceedings. ICRA '02. IEEE International Conference on, vol.1, no., pp.1037, 1042, 11-15 May 2002

[4] Maass, R.; Zahn, V.; Eckmiller, R., *"Neural force/position control in Cartesian space for a 6DOF industrial robot: concept and first results,"* Neural Networks,1997., International Conference on , vol.3, no., pp.1744,1748 vol.3, 9-12 Jun 1997