OSES

Embedded System Specifications

Remote control unit for a wheeled robot

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301514 Jonathan Damone
294974 Lorenzo Mastrorosa
227170 Maciej Lampart

One sentence Robot Proposal

A robot has to navigate from point A to point B.
The environment is simulated through a matrix where 0 is terrain that can be crossed a 1 is an obstacle that must be avoided.
The matrix is stored on a file or, if reading the file ends up being too slow, on a variable in memory.
The robot can move only in 8 directions (up, down, left, right and diagonals).
To fulfill his task the robot's OS performs the following tasks:

Task summary

Task	Type	Deadline	N of bit	specifications	Rule
Location	Periodic	2 ms	-	mandatory	location of the robot in the Matrix
Obstacle	Periodic	0.5 ms	8	mandatory	measure distances
Navigation	Periodic	1 ms	8	mandatory	direction for the robot
Motion	Periodic	1 ms	8	mandatory	update to the position according to the direction
Proximity	Aperiodic	0.5 ms	4	optional	too close to an obstacle
On/off	Sporadic	3 ms	1	optional	off or restart

Task

• **Location task**: periodically determines the location of the robot, here simulated by counting the characters from the current position to the two borders of the matrix.
Of course, the position is already known and the counting is performed just to make this task do some operations.
Alternatively, the position of the robot could be marked on the matrix with a special character so that the position isn't known a prior and must be figured out every time by reading the whole matrix.
optionally could be derived and confirmed by the Obstacle Detection Task.

• **Obstacle Detection** : tasks measure distances to the obstacles, here simulated by counting zeros until a one is encounter red. The task has 8 different instances, one for each direction.

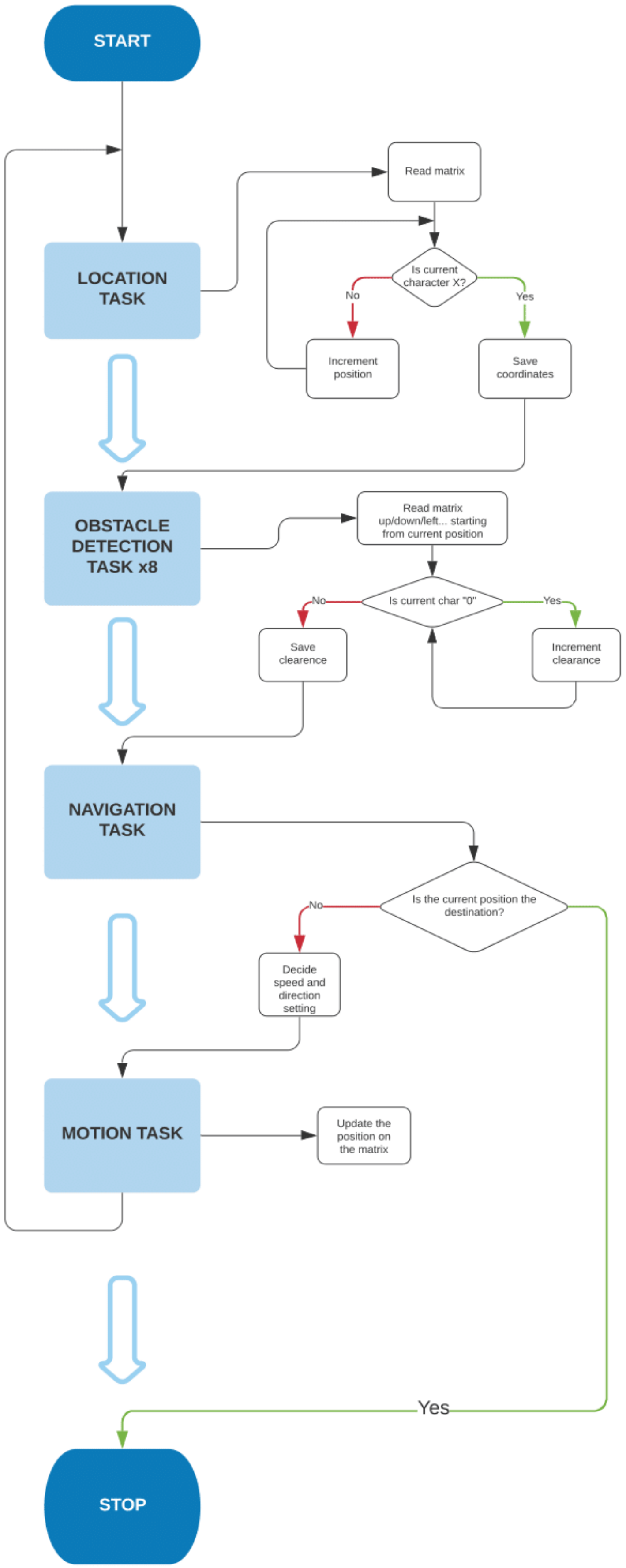
• **Navigation task**: using data obtained by the above tasks, determines the most convenient direction for the robot to reach the destination.

• **Motion task**: performs a periodic update to the position of the robot according to the direction and set by the navigation task. This task has the scope of simulating movement which cannot be changed unless proper action is taken by the Navigation task.
Thus, the Motion task should have the highest priority and be able to preempt other
tasks so that, if the previous tasks don't meet time requirements a crash might occur.

• **Proximity task**: Optionally, we can introduce tasks that take into account if our robot gets too close to an obstacle, generating an interrupt that blocks the movement task. (optional)

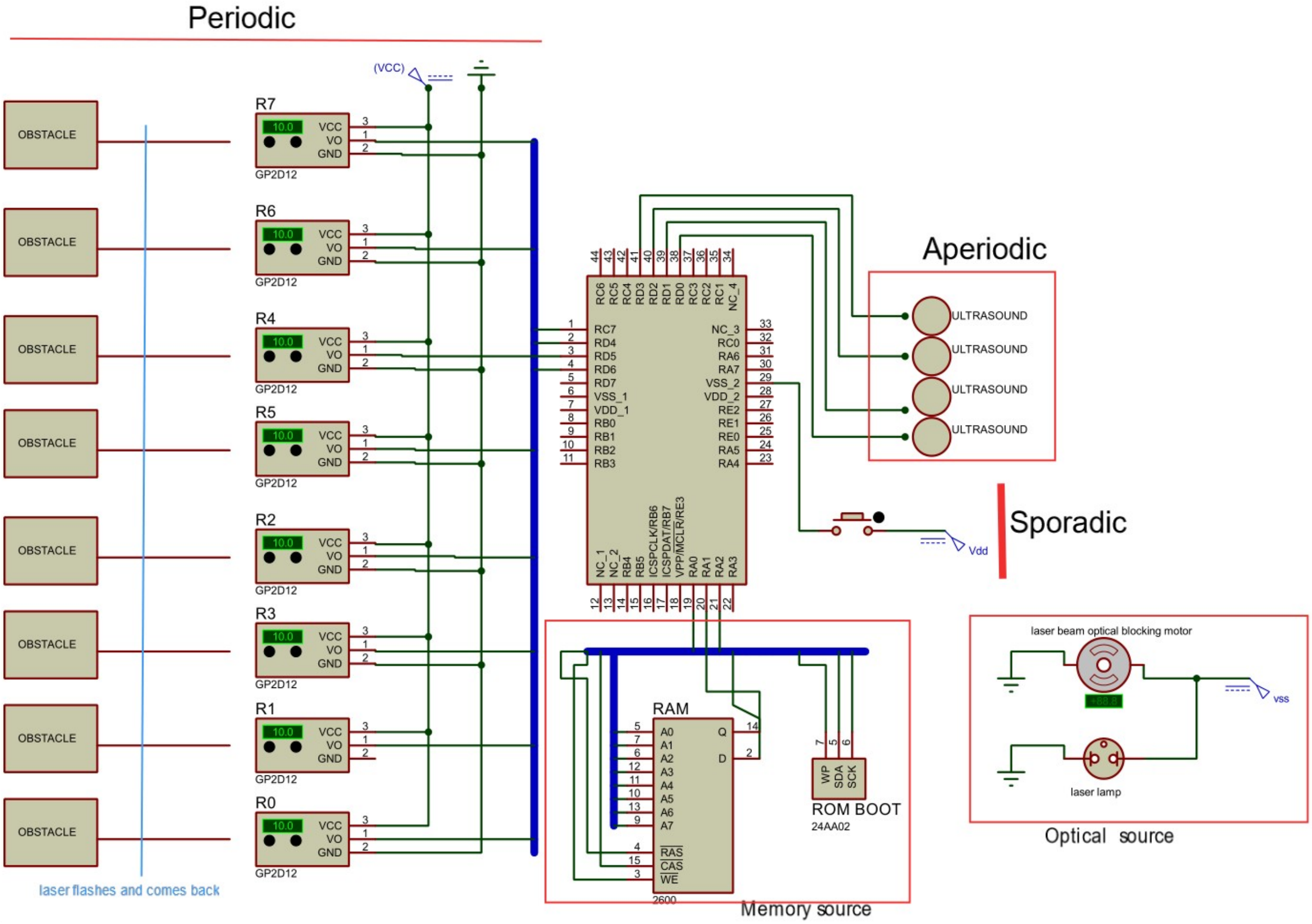
On/off task: optionally, we can add a task that detects the command from an operator wishing to switch off or restart the robot's run. (optional)

Flowchart


START
LOCATION TASK
Read matrix
Is current character X?
No
Yes
Increment position
Save coordinates
OBSTACLE DETECTION TASK x8
Read matrix up/down/left... starting from current position
Is current char "0"
No
Yes
Save clearence
Increment clearance
NAVIGATION TASK
Is the current position the destination?
No
Decide speed and direction setting
MOTION TASK
Update the position on the matrix
Yes
STOP

Map of peripherals

The representation of the controller in the centre is purely representational.
this diagram of the peripheral elements helps us to understand the connection between the various tasks and the real elements.



Periodic block: is the peripheral device responsible for detecting the distance to obstacles, with eight directions of movement, the laser receptors are 8, corresponds to **object detection task,**
The connection to the card can be made either directly or via a bus.

Aperiodic block: use of ultrasound which, unless objects are detected at a very short distance, does not tend to signal anything, but when there is an object it sends a danger signal to the system; corresponds to Proximity task**.**

Sporadic block: the machine's on/off signal does something before switching on/off.
which protects and performs certain operations to ensure that certain electromechanical and electronic operations are completed correctl; corresponds to **on/off Task.**

optical source: represents a laser optical propagation instrument (the original name is LIDAR) that propagates light beams in directions of interest to us. These beams are switched on and off through a movable panel that blocks the light in one direction so that the return can be calculated once established.
Since this is an optoelectronic-mechanical element it is not of we only need to know that when the laser is covered, it sends a signal to the control unit, which we can read to understand the time elapsed.

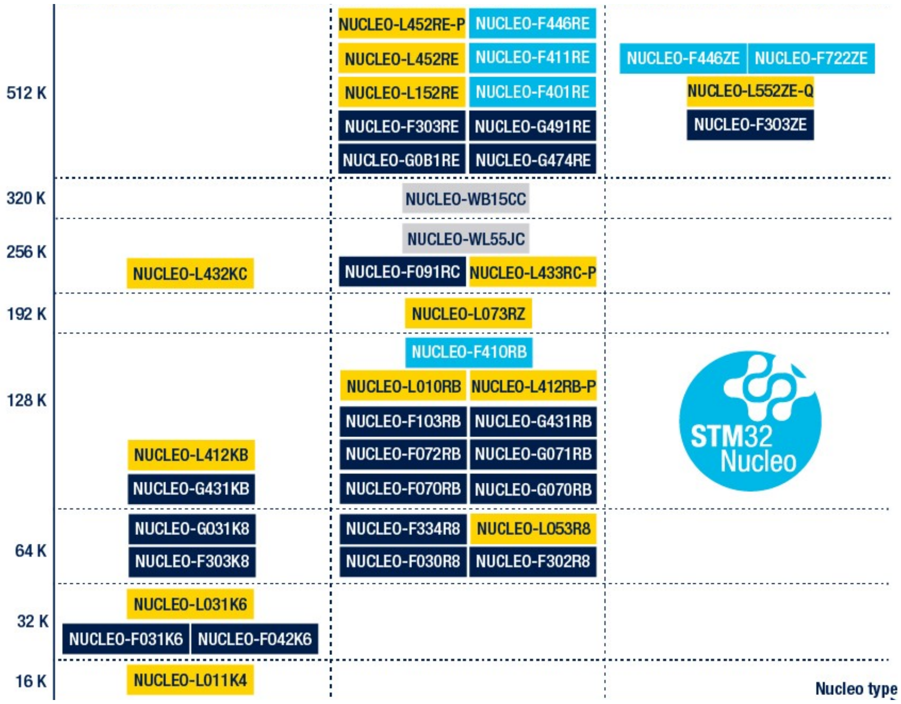
Memory block: this block represents the memory where the matrix and the RT operating system will be stored. it could be external if you design only with the cpu or internal if you design with a boad.

I/O Design

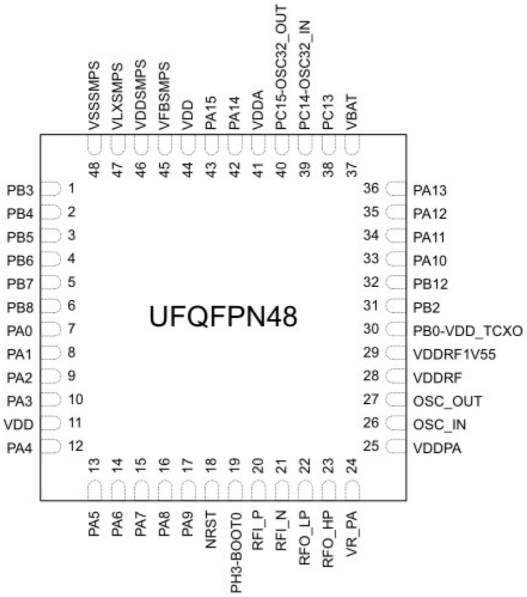
Name	Type	Number pin	Scheduling	expected result
Laser sensor	input	3	Periodic	Reading the laser arrival signal (fly time)
Ultrasonic	input	2	Aperiodic	Reading ultrasonic sensor
On/off	input	1	Sporadic	On or off device
Direction	output	3	Periodic	signal communicating in which direction to go
Matrix update	Inout	-	Periodic	writing and reading the next and current position in the matrix plane

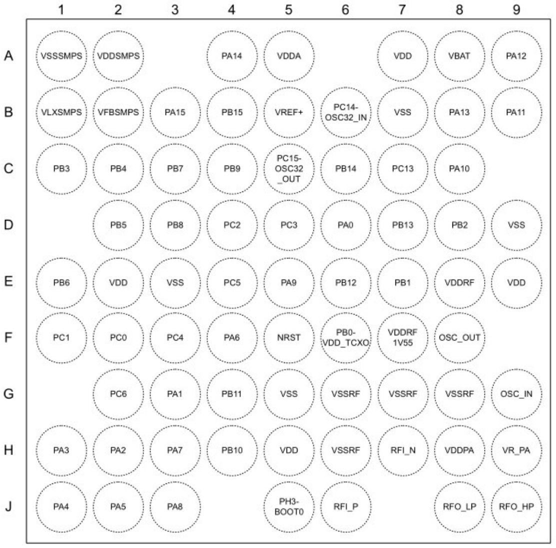
Choice of HW platform to host RT-Thread

In the list of supported boards, the STM8 family is the largest.
in particular, to avoid having too small a memory among the many the Nucleo family has a large variety of size, STM32WL55JCI.



From the datashhet we can see that the memory module is named UFQFPN48.





	1	2	3	4	5	6	7	8	9
A	VSSSMPS	VDDSMPS		PA14	VDDA		VDD	VBAT	PA12
B	VLXSMPS	VFBSMPS	PA15	PB15	VREF+	PC14- OSC32_IN	VSS	PA13	PA11
C	PB3	PB4	PB7	PB9	PC15- OSC32 _OUT	PB14	PC13	PA10	
D		PB5	PB8	PC2	PC3	PA0	PB13	PB2	VSS
E	PB6	VDD	VSS	PC5	PA9	PB12	PB1	VDDRF	VDD
F	PC1	PC0	PC4	PA6	NRST	PB0- VDD_TCXO	VDDRF 1V55	OSC_OUT	
G		PC6	PA1	PB11	VSS	VSSRF	VSSRF	VSSRF	OSC_IN
H	PA3	PA2	PA7	PB10	VDD	VSSRF	RFI_N	VDDPA	VR_PA
J	PA4	PA5	PA8		PH3- BOOT0	RFI_P		RFO_LP	RFO_HP

With 3 ports called A, B, C with 48 pins of I/O sufficient for our purposes with an internal memory of 256k of memory sufficient for our purposes or otherwise extendable through the use of core cards with higher memory but our interest is restricted to this one because in addition to an electronic model than the other has a peripheral connection for wireless modules that are a milestone in autonomous driving.